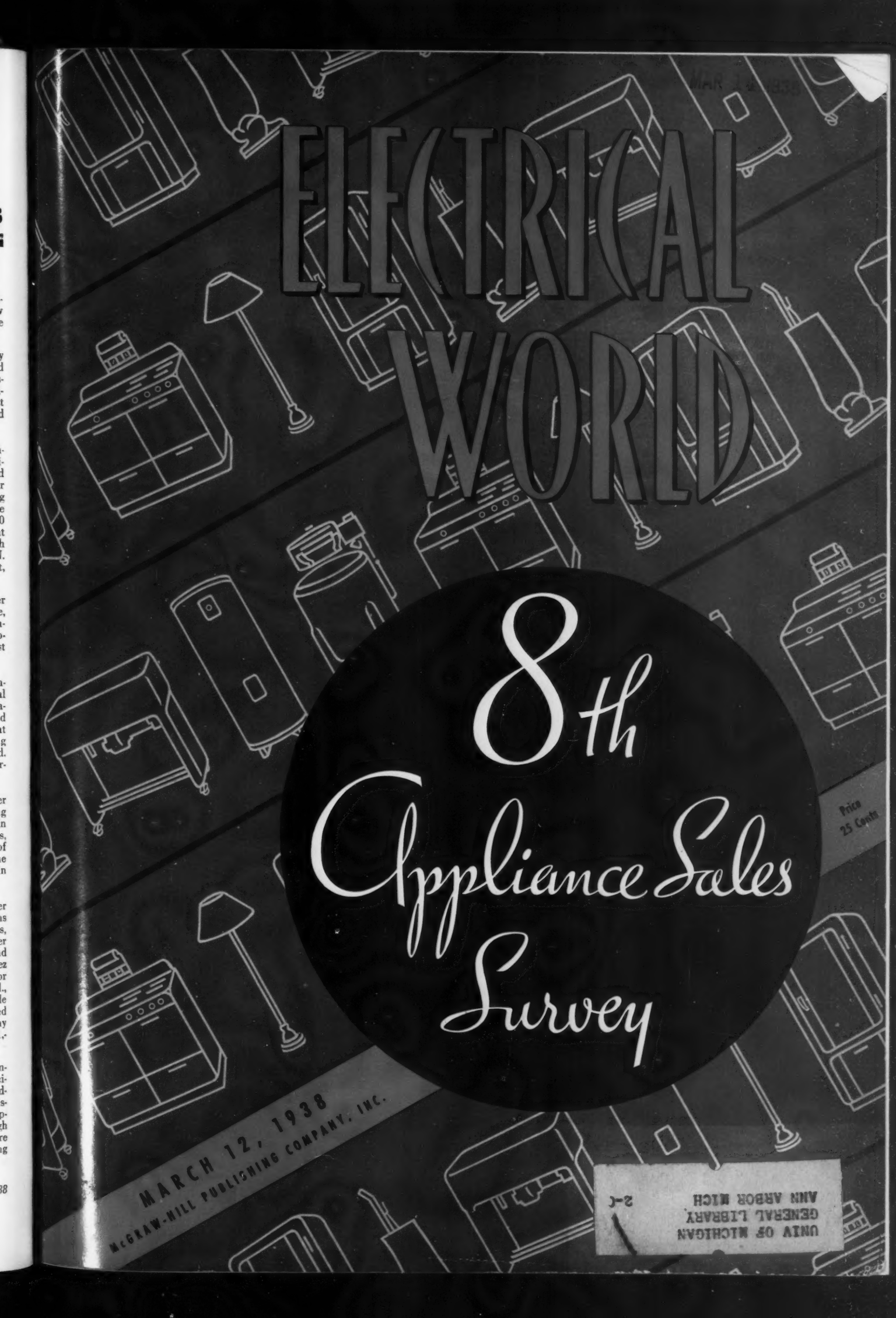

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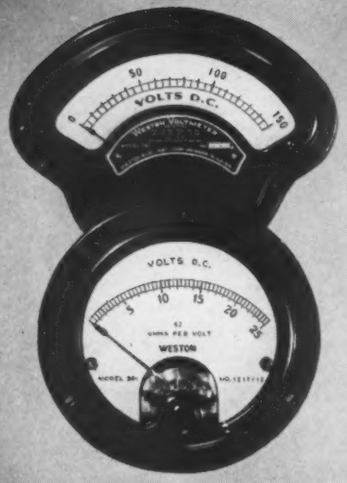

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Letters TO THE EDITOR

Tapped Transmission for Substation Seven Years Ago

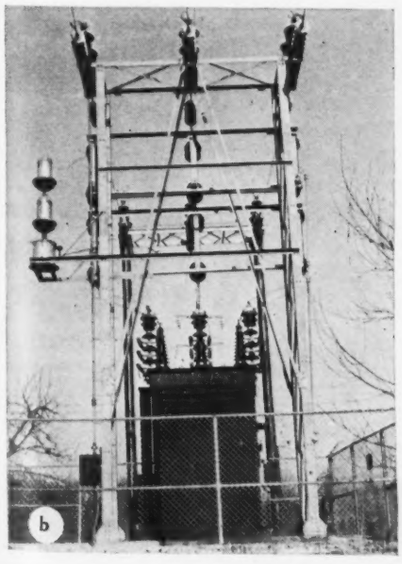
To the Editor of ELECTRICAL WORLD:

I was very much interested in the article entitled "Transmission Tapped for Distribution by New Unit," by Messrs. Van Antwerp and Warford, which appeared in the January 1 issue of the ELECTRICAL WORLD. The article, however, appears to give the impression that this is an entirely new development, which is far from the case. We have been using this same principle since 1931, and an article on this subject entitled "Rural Substation to Meet Seven Requirements" was published in the July 2, 1932, issue of your magazine. The essential difference between the unit described and that used by us is in the inclusion of the switchgear in the transformer case, whereas our practice has been to bolt a switchhouse to the side of the transformer case. This difference obviously is a matter of judgment based on the engineering and economic factors of the particular application. In our case the separation of the switchgear and transformer was decided as more favorable, since we felt that the very slight increase in manufacturer's cost was outweighed by the increase in flexibility, ease of maintenance and lack of congestion, which is necessarily present in the single unit design.

We have four of these unit substations in service, and a fifth will be placed in service early this spring. The primary voltages vary from 13.8 kv. to 66 kv. and the sizes from 750 to 1,000 kv., with the possibility of increasing these ratings 25 per cent by means of forced air cooling. I am enclosing photographs of two of these units, one operating from a 13.8-kv. line, the other from a 66-kv. line. It will be noticed that the 13.8-kv. unit is fully metal inclosed, the primary and secondary being brought into the unit by short cable connections from the overhead line. This obviates the necessity of any inclosure, though we have found it desirable to install a 3-ft. fence around the unit. The 66-kv. unit is tapped directly to the 66-kv. line by means of a light steel superstructure built right over the unit on which is mounted the disconnects and fuses. The unit may be installed in the line or to a side as conditions demand.

It may be of interest to note that we have also had occasion to take advantage of the ease of moving these units. It became necessary in one instance, due to change in load distribution, to move a unit several miles. This change was accomplished in a comparatively short time, the major cost being in transportation and rearrangement of circuits outside of the station.

GEORGE H. LANDIS,
Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.



Four units already installed, fifth due this spring

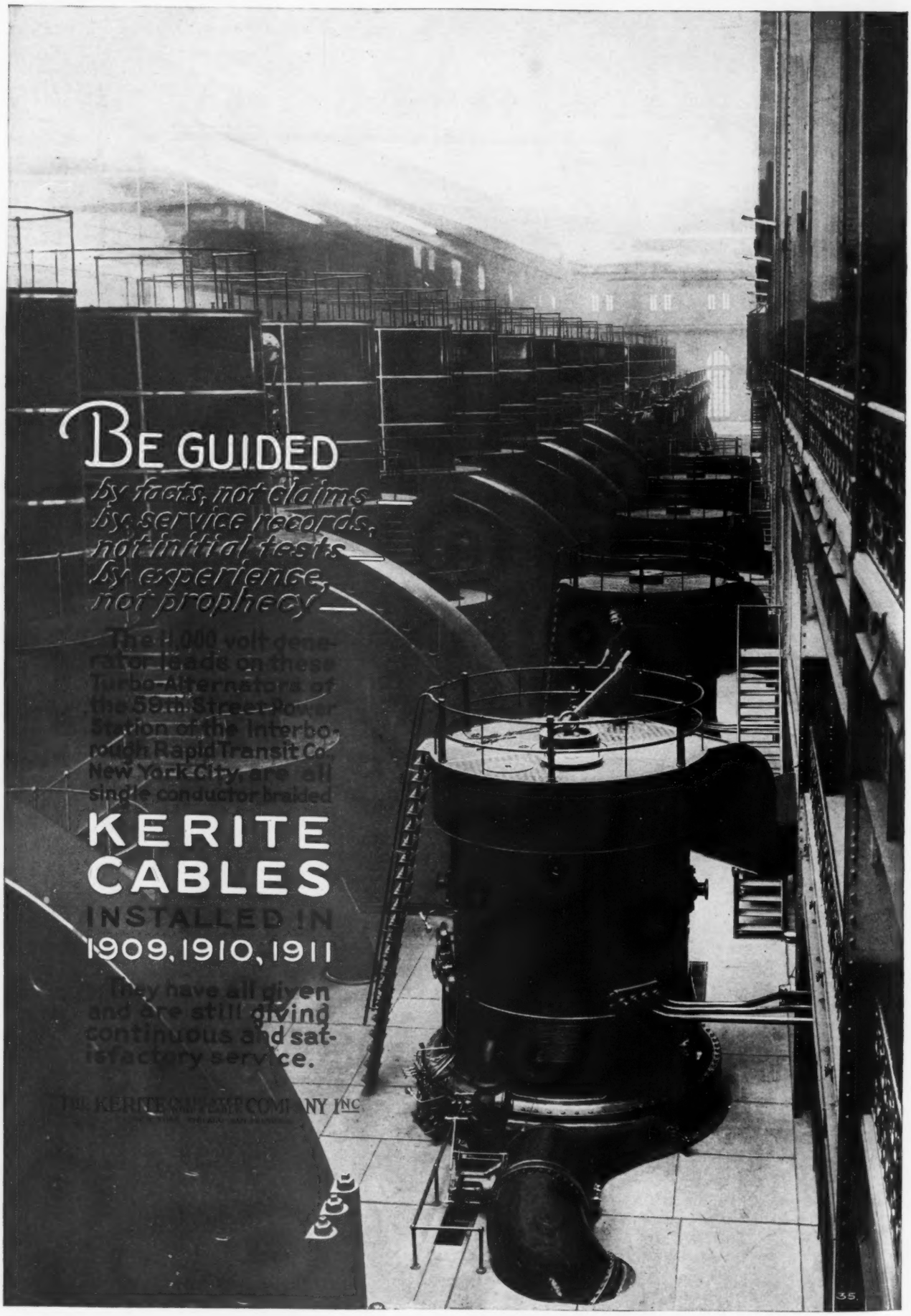
(a) Cold Spring substation is 750 kva., 13.2/4.8 kv. It has 15% automatic tap changing under load controlled by contact-making voltmeter with compensation. High-voltage side controlled by three-pole gang switch and three liquid-filled fuses, all mounted in transformer case. Bolted to transformer in switch house are three automatic reclosers for 4.8-kv. feeder. (b and c) Lagrangeville unit is 1,000 kva., 66/4.2 kv. Has 10 per cent tap changer. Three expulsion fuses (high-voltage side) on steel H-frame structure. Automatic reclosers for 4.2 kv. H-frame also supports motor-operated air-break switch controlled by 66-kv. capacitor to sectionalize 66-kv. line automatically

Limits of Monthly Charges for Carrier Relay Protection

To the Editor of ELECTRICAL WORLD:

In the ELECTRICAL WORLD of February 12, on page 49, in commenting on my A.I.E.E. discussion, there is one sentence which is possibly misleading to those who did not hear my discussion in full. You state "communication channel rentals are typified by $100 per month per terminal." What I stated was that, using the percentage of fixed charges used by communication companies on electronic and switchboard equipment, the fixed charges on power line carrier relay protection at $4,000 to $4,500 per terminal would amount to $100 per month per terminal. This figure compares with about $40 using a percentage of overhead charges frequently used by power companies on power plants or even on complete power systems where some of the property has a very long life, little obsolescence and does not require skilled

[*Continued on page 144*]


BE GUIDED
by facts, not claims—
by service records, not initial tests—
by experience, not prophecy—
The 11,000 volt generator leads on these Turbo-Alternators of the 59th Street Power Station of the Interborough Rapid Transit Co. New York City, are all single conductor braided
KERITE CABLES
INSTALLED IN 1909, 1910, 1911
They have all given and are still giving continuous and satisfactory service.
THE KERITE INSULATED WIRE & CABLE COMPANY INC.
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ELECTRICAL WORLD

MARCH 12, 1938

Industry Owes a Responsibility to Education

An interesting series of meetings have been held during the past year between members of the engineering faculty of Princeton University and members of industry for the purpose of arranging a curriculum for students in engineering at Princeton that would best fit them for employment. Each branch of engineering has been studied by a committee of men in that industry who were chosen to represent a wide diversity of employment.

The recommendations that have come out of these several groups are virtually the same, irrespective of the kind of engineering involved. Men are wanted by industry who have a sound foundation of basic engineering on which can be built in employment the current practice of the industry. Men are wanted who have a broad education fairly balanced between the arts, science and the theory of engineering. Men are wanted who can become leaders of men and leaders of industry.

These conferences, however, not only are bringing about a change in the educational program of one university, but they are causing industry to realize that education is not entirely a matter for a group of professors to work at, but it is equally a responsibility for industry itself. When industry buys raw materials and equipment it has a specification, and it frequently works with the supplier to find the best way of meeting this specification. For labor, however, and particularly that branch of labor from which industry is going to recruit its future executives, engineering directors, designers, operators, etc., industry has no specification. Why?

Of course, men cannot be tested as one would test materials. Some men develop early and some develop late. The human element is a variable. Nevertheless, the training a man gets at college will determine, in large measure, his approach to the job and his ability to progress. That training can be specified. In fact, many large companies have set up definite standards for training men. If it is possible to set up such standards, why is it not possible to set up standards for college training that will better fit graduates for employment?

This co-operative effort at Princeton is but a start. Beyond the curriculum is a wider and perhaps even more important field for joint industry-faculty study. Some of the elements that need study are:

The kind of boy who is permitted or encouraged to take up engineering.

The qualifications of professors and instructors in the engineering courses and the degree to which they keep up to date in practice.

The text books used and the laboratory equipment available.

Opportunities for summer employment of both students and faculty members.

Interchange of faculty and industrial employees for short terms.

Extension education.

Inspection trips.

Co-operative research.

Education is a very practical matter, both for the student and for the employee. It involves one of the most, if not the most, important raw materials of industry. It is industry's responsibility to see that education makes the most of its four-year opportunity. Most educational institutions would welcome a joint study of engineering education. The initiative, however, should come from industry as the future employer of engineering graduates.

Economics of Subsidized Power—II

If Subsidy for Hydro,

Even with annual charges subsidized by escape from taxes and by lower price for government money, hydro must descend to an unreasonably low unit cost to compete with steam in economy of power supply at delivery point. Subsidy only reduces, does not wipe out, difference between coal haul and electric transmission costs—coal haul still is cheaper.

DURING the lapse of nearly two years since the first part of this paper was presented* there has been very extensive discussion of electric power costs in both the technical press and in many newspapers and magazines of general circulation. The trend of independent engineering opinion is well known, but rather recently there have been some interesting assertions from advocates of public enterprise in the utility field that hydro power is cheaper than steam power. Where figures have been advanced to support this assertion, an examination of them discloses the fact that the comparison is drawn between steam power generated by private enterprise and hydro power generated by public enterprise. Furthermore, it is assumed in those comparisons that private enterprise must bear the normal cost of capital and the full burden of taxes, whereas public enterprise is subsidized by obtaining capital at about half the normal cost to private enterprise and by complete relief from taxation.

Almost the first question which presents itself is why such a comparison should be set up on a one-sided or prejudiced basis. If a subsidy is assumed on one side of the comparison, why should it not be assumed on both sides? The next question, obviously, is what effects these subsidies will have on the cost of power, if granted impartially to both types of generation set up in the comparison. The purpose of this paper is to discuss these questions, using as a starting point the costs for steam and hydro set forth in the original paper.* The same subsidies will be applied to both types of generation, to show how they affect the cost of power in both instances and, of course, how they affect the comparison.

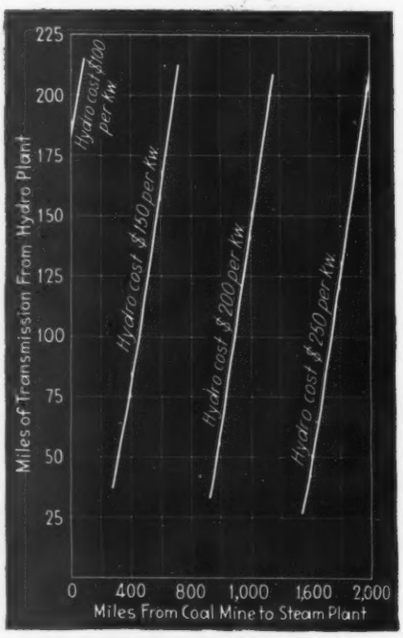


Fig. I—Unsubsidized power. Coal hauls equivalent to electric transmission for same total power cost

Annual charges on the plant investment, comprised of return on capital, taxes, depreciation and an allowance for overhead, were taken in the first instance at 12.5 per cent on the steam plant and 10.5 per cent on the hydro plant. These totals include normal return on capital at 7 per cent and taxes at 2 per cent, in both cases. The subsidy is assumed to consist of a reduction of 3.5 per cent in the return on capital and the omission of the 2 per cent allowance for taxes, or a combined reduction of 5.5 per cent from the previous totals. The breakdown in detail is shown below:

	At Full Normal Cost		Under Subsidy	
	Steam	Hydro	Steam	Hydro
	Per Cent		Per Cent	
Interest	7.0	7.0	3.5	3.5
Taxes	2.0	2.0	..	..
Depreciation	3.0	1.0	3.0	1.0
Overhead	0.5	0.5	0.5	0.5
Totals	12.5	10.5	7.0	5.0

The annual charges on the transmission line, including the step-up and step-down terminals, have been taken at 12.5 per cent for the full normal cost and 7 per cent for the subsidized cost. However, in these two cases the item of 3 per cent for depreciation is assumed to cover both depreciation and repairs, whereas in the case of generating plants the cost of repairs is taken care of under another item.

Comparative cost of generation

The comparison of generation costs has been set up on the same basis as shown in Table 17† in Part I of this paper. The steam plant has been treated as 100 per cent dependable; that is, up to its full installed capacity. Similarly, the firm capacity of the hydro plant has been treated as 100 per cent dependable. Both of these figures would be shaded a little in operating practice, but for purposes of comparison any prejudice is eliminated by taking both on the same basis. The general question of available reserve capacity is

* Abstracted from "The Nation's Power Supply, Part II, The Economics of Subsidized Power," presented at the twenty-second Fuel Engineering Conference, sponsored by Appalachian Coals, Inc., in Atlanta, Ga., February 8, 1938. This paper is a continuation of "The Nation's Power Supply, Its Economic Development Under Private Enterprise," presented at the sixth Midwest Power Engineering Conference in Chicago, April 22, 1936, and abstracted at length in ELECTRICAL WORLD, June 20, 1936.

† Table VI in ELECTRICAL WORLD abstract of June 20, 1936.

Why Not for Steam?

By FRANK F. FOWLE
*Consulting Engineer, Chicago, Ill.**

left out of the picture on both sides, to simplify the comparison. It is also assumed in all instances that the generating plant includes no step-up substation for transmission or distribution; that is to say, power is delivered only to the station bus, at generator voltage.

The estimated costs of generation, for steam and hydro, under normal and subsidized rates for capital and taxes, are shown in Table I. However, the original basis assumed for the hydro plant has been extended to cover a range of cost per kilowatt of firm capacity from $250 down to $100, in $50 steps. The costs of generation per kilowatt-hour as shown in Table I are summarized below:

		Hydro			
	Steam	At $250 per Kw.	At $200 per Kw.	At $150 per Kw.	At $100 per Kw.
Normal basis	3.97	6.30	5.10	3.90	2.70
Subsidized basis	2.90	3.15	2.58	2.01	1.44

These figures show that the subsidy favors hydro somewhat more than steam, because hydro costs are comprised in greater proportion of fixed charges. Under steam generation the subsidy reduces the cost of energy 27 per cent, whereas under hydro generation the subsidy reduces the cost by about 47 to 50 per cent in the cases shown. On a normal basis of cost, hydro generation is not cheaper than steam unless the hydro plant costs less than approximately $150 per kilowatt. On a subsidized basis hydro generation is cheaper when the hydro plant costs less than approximateely $225 per kilowatt. These comparisons include no transmission, in any instance.

In the matter of cross-comparisons, it is interesting to observe that subsidized steam generation is cheaper than hydro generation under normal costs unless the hydro plant costs less than approximately $110 per kilowatt. On the other hand, subsidized hydro generation is cheaper than steam generation under normal costs unless the hydro plant costs more than approximately $320 per kilowatt.

Comparative cost of generation and transmission

The comparison of transmission costs has been set up on the same basis as in the earlier paper, with the exception that the transmission line is assumed to be supplied from a hydro plant. This has the effect of including the cost of losses in transmission at the cost of hydro generation, which provides a logical comparison with the cost of hauling an equivalent tonnage of coal from mine to steam plant.

Tables II and II show the estimated normal cost of energy transmission for three hypothetical cases, one of 200 miles at 220 kv., one of 100 miles at 132 kv. and one of 50 miles at 66 kv. The results shown in these tables are summarized in Table IV and the costs of hydro generation are added to the costs of transmission, producing the estimated total costs of unsubsidized and subsidized energy delivered at the end of the line. From these total costs the cost of steam generation are deducted, leaving the excesses of hydro costs over steam, which are converted into equivalent mileages of coal haul according to the formula used in the earlier paper:

$$\text{Freight rate per ton} = \$0.90 + \$0.0035\ L$$

where the item of $0.90 is a switching charge and L is the length of haul in miles. At the assumed efficiency of 1.18 lb. of coal per kilowatt-hour, this formula can be ex-

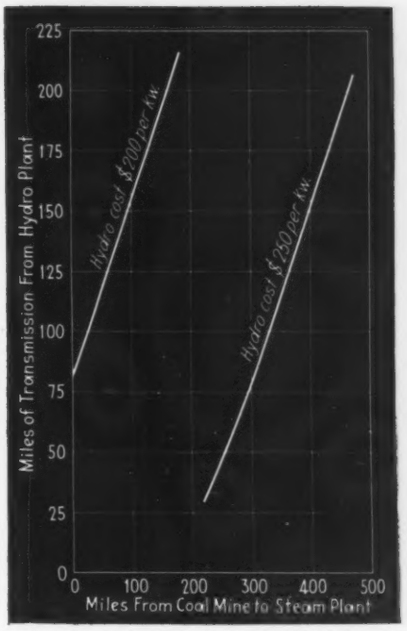


Fig. II—Subsidized power. Coal hauls equivalent to electric transmission for same total power cost

Table I—Comparison of Unsubsidized and Subsidized Generation Costs* for Steam Plant and for Hydro Plant at Various Costs per Kw.

	Steam Plant Built at Mine Mouth		Hydro Plant Located at Dam Site							
			Cost — $250 per Kw.		Cost — $200 per Kw.		Cost — $150 per Kw.		Cost — $100 per Kw.	
	Unsubsidized	Subsidized	Unsubsidized	Subsidized	Unsubsidized	Subsidized	Unsubsidized	Subsidized	Unsubsidized	Subsidized
Annual fixed charges	$1,063,000	$595,000	$2,625,000	$1,250,000	$2,100,000	$1,000,000	$1,575,000	$750,000	$1,050,000	$500,000
Annual operating charges	$677,000	$677,000	$131,000	$131,000	$131,000	$131,000	$131,000	$131,000	$131,000	$131,000
Total annual cost	$1,740,000	$1,272,000	$2,756,000	$1,381,000	$2,231,000	$1,131,000	$1,706,000	$881,000	$1,181,000	$631,000
Costs per kw.-hr. (Mills)	3.97	2.90	6.30	3.15	5.10	2.58	3.90	2.01	2.70	1.44

* Bases for calculation are:

Plant capacity, 100,000 kw.: annual load factor, 50 per cent annual production, 438,000,000 kw.-hr.

Cost of steam plant, $85 per kw.; of hydro plant, as shown above.

Annual fixed charges for steam plant, unsubsidized, 12.5 per cent subsidized, 7 per cent: for hydro plant charges are 10.5 and 5 per cent respectively.

Annual steam plant fuel cost calculated on coal at $1.60 per ton burned at rate of 1.18 lb. per kw.-hr.

Operating and supervisory labor and repairs estimated at 0.6 mill per kw.-hr for the steam plant and at 0.3 mill per kw.-hr. for the hydro plant.

Table II—Costs of Hydro Plant Transmission Systems*

	220 Miles at 200 Kv. Twin Circuits	100 Miles at 132 Kv. Twin Circuits	50 Miles at 66 Kv. Twin Circuits
Rated output per circuit (kw.)	150,000	60,000	25,000
Total output, two circuits (kw.)	300,000	120,000	50,000
Annual load factor (per cent)	50	50	50
Annual transmission efficiency (per cent)	90	90	90
Annual input, kilowatt-hours	1,460,000,000	584,000,000	243,300,000
Annual output, kilowatt-hours	1,314,000,000	525,600,000	219,000,000
Transmission loss, kilowatt-hours	146,000,000	58,400,000	24,300,000
Cost of complete line, per mile	$50,000	$22,000	$13,000
Total cost of line	$10,000,000	$2,200,000	$650,000
Cost of two complete terminals	$6,750,000	$2,400,000	$800,000
Total cost of transmission system	$16,750,000	$4,600,000	$1,450,000

* Editor's Note — Transmission line capacities used here do not correspond with assumed capacity of hydro plants associated with them. But for the determination of unit costs of energy transmission correspondence between line and plant capacities is not necessary. As a practical matter there would have to be three or possibly four 132-kv. circuits for a 100,000-kw. plant and at the very least five 66-kv. circuits for reliable service. These requirements would increase total costs of transmission lines very greatly.

Table III—Comparison of Costs of Transmitting Electricity vs. Costs of Hauling Coal*

	Hydro P'ant —at $250 per Kw.— Unsubsidized	Hydro P'ant —at $250 per Kw.— Subsidized	Hydro P'ant —at $200 per Kw.— Unsubsidized	Hydro P'ant —at $200 per Kw.— Subsidized	Hydro P'ant —at $150 per Kw.— Unsubsidized	Hydro P'ant —at $150 per Kw.— Subsidized	Hydro P'ant —at $100 per Kw.— Unsubsidized	Hydro P'ant —at $100 per Kw.— Subsidized
Energy Transmitted 200 Miles at 220 Kv.								
Total annual transmission cost.	$3,013,000	$1,633,000	$2,838,000	$1,550.000	$2,663,000	$1,467,000	$2,488,000	$1,384,000
Transmission cost — Mills per kw. hr.	2.29	1.24	2.16	1.18	2.03	1.12	1.89	1.05
Freight on coal for 200 miles on equal energy production — Mills per kw. hr	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Savings by transportating coal — Mills per kw. hr	1.35	0.30	1.22	0.24	1.09	0.18	0.95	0.11
Coal haul (miles) for cost equal to transmission	850	345	790	315	725	285	660	250
Energy Transmitted 100 Miles at 132 Kv.								
Total annual transmission cost.	$943,000	$507,000	$873,000	$473,000	$803,000	$440,000	$733,000	$407,000
Transmission cost — Mills per kw. hr.	1.80	0.96	1.66	0.90	1.53	0.89	1.40	0.77
Freight on coal for 100 miles on equal energy production — Mills per kw. hr.	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Savings by transporting coal — Mills per kw. hr	1.06	0.22	0.92	0.16	0.79	0.10	0.66	0.03
Coal haul (miles) for cost equal to transmission	615	210	545	180	485	150	420	115
Energy Transmitted 50 Miles at 66 Kv.								
Total annual transmission cost.	$334,000	$178,000	$305,000	$165,000	$276,000	$151,000	$246,000	$137,000
Transmission cost — Mills per kw. hr.	1.52	0.81	1.39	0.75	1.26	0.69	1.12	0.63
Freight on coal for 50 miles on equal energy production — Mills per kw. hr	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Savings by transporting coal — Mills per kw. hr	0.88	0.17	0.75	0.11	0.62	0.05	0.48	—0.01
Coal haul (miles) for cost equal to transmission	480	135	415	105	3.55	77	285	48

* Methods of calculation are:

Total annual transmission costs are sums of fixed charges on line investments (Table II) at unsubsidized (10.5 per cent) and subsidized (5 per cent) rates, plus fixed charges on additional plant investments required by line losses (Table II) at the two rates, plus operating costs on production of line loss energy (as in Table I).

The annual output of the line (Table II) is used to determine cost in mills per kw.-hr.

Freight on coal in mills per kw.-hr = 0.531 % 0.002065 L, in which L is distance in miles. This formula is explained in the text.

Equivalent coal haul is calculated from transmission cost in miles per kw.-hr. by means of the freight cost formula.

Table IV—Coal Hauls Allowable to Steam Power for Same Delivered Power Cost as for Transmitted Hydro Power*

	Hydro Plant —at $250 per Kw.— Unsubsidized	Hydro Plant —at $250 per Kw.— Subsidized	Hydro Plant —at $200 per Kw.— Unsubsidized	Hydro Plant —at $200 per Kw.— Subsidized	Hydro Plant —at $150 per Kw.— Unsubsidized	Hydro Plant —at $150 per Kw.— Subsidized	Hydro Plant —at $100 per Kw.— Unsubsidized	Hydro Plant —at $100 per Kw.— Subsidized
Energy Transmitted 200 Miles at 220 Kv.								
Cost of transmitted hydro power — Mills per kw. hr.	8.59	4.39	7.26	3.76	5.93	3.13	4.59	2.49
Cost of mine mouth steam power — Mills per kw. hr	3.97	2.90	3.97	2.90	3.97	2.90	3.97	2.90
Excess cost of hydro over steam power — Mills per kw. hr.	4.62	1.49	3.29	0.86	1.96	0.23	0.62	—0.41
Coal haul for equal hydro and steam power cost — Miles	1,980	465	1,340	160	690	†	43	†
Energy Transmitted 100 Miles at 132 Kv.								
Cost of transmitted hydro power — Mills per kw. hr	8.10	4.11	6.76	3.48	5.43	2.85	4.10	2.21
Cost of mine mouth steam power — Mills per kw. hr	3.97	2.90	3.97	2.90	3.97	2.90	3.97	2.90
Excess cost of hydro over steam power — Mills per kw. hr.	4.13	1.21	2.79	0.58	1.46	—0.05	0.13	—0.69
Coal haul for equal hydro and steam power cost — Miles	1,740	330	1,090	25	450	†	†	†
Energy Transmitted 50 Miles at 66 Kv.								
Cost of transmitted hydro power — Mills per kw. hr.	7.82	3.96	6.49	3.33	5.16	2.70	3.82	2.07
Cost of mine-mouth steam.	3.97	2.90	3.97	2.90	3.97	2.90	3.97	2.90
Excess cost of hydro over steam power — Mills per kw.-hr.	3.85	1.06	2.52	0.43	1.19	—0.20	—0.15	—0.83
Coal haul for equal hydro and steam power cost — Miles	1,610	255	965	0	320	†	†	†

* Bases for calculation are:

Cost of transmitted hydro power is sum of generation (Table I) and transmission (Table III) costs. (Editor's Note — Again be it remarked that Mr. Fowle's calculation of transmission cost does not include labor, supervision and other costs for operation and maintenance of the transmission line and that the figures given here are bottom values below what actual costs would be.)

Cost of mine-mouth steam power, which does not include any charge for coal transportation, is from Table I.

Equivalent coal haul is calculated from excess cost of hydro over steam power by use of the formula referred to in notes appended to Table III and explained in the text.

† In the particular conditions, transmitted hydro power is more economical than local steam power production.

pressed in mills per kilowatt-hour as follows:

$$\text{Freight cost per kw.-hr.} = 0.531 + 0.002065\ L$$

The mileages of coal hauls for equal total normal costs of energy are shown graphically in Fig. I. Steam power is shown to be cheaper than hydro, for most localities, unless the cost of the hydro plant is less than about $125 per kilowatt. The mileages of coal hauls for equal total subsidized costs of energy are shown in Fig. II. Subsidized steam power is shown to be cheaper than subsidized hydro, for most localities, when the hydro plant costs $250 per kilowatt. At a cost of $200 per kilowatt for the hydro plant, and upward of 100 miles of transmission, steam power is still in the picture if the coal haul is rather moderate. At a cost of $150 per kilowatt for hydro plant steam is out of the picture entirely.

Advantages and disadvantages of subsidy

On the assumption that the entire subsidy is passed on to the customers of the system, and the rate structure is scaled down with reasonable uniformity, it will follow that the benefits will accrue to all classes of users served. On the basis of national usage for the year 1933 it is interesting to observe that residential, domestic and farm users would receive about 18 per cent of the subsidy, while large light and power and railroad customers would receive about 58 per cent of it. The benefits passed on to business and industry would accrue, obviously, to the owners of those enterprises.

There are those who hold to the

[*Continued on page 139*]

Demand Registers Tested Rapidly

Device for individual testing of registers found in error by gang checker increases production because operation of gang is not slowed down by time required for register adjustments

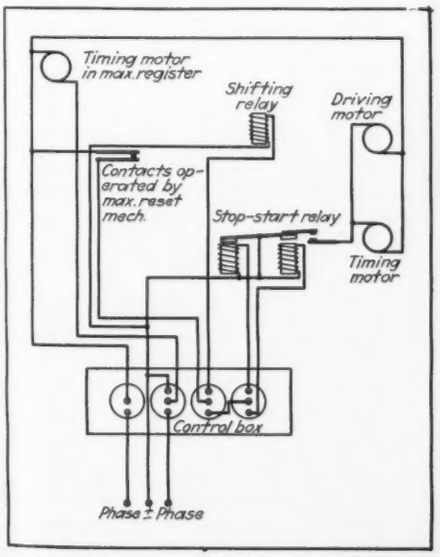
By EARL L. HURT

Meter Department, Public Service Company of Northern Illinois

APPROXIMATELY 60 per cent reduction in the cost of testing demand meter registers has been accomplished in the meter department of Public Service Company of Northern Illinois by a combination of gang checking and automatic single checking. The successful operation of the locally developed equipments and methods has proved that gang testing of demand registers can improve greatly production volume of tests without in any way sacrificing accuracy. The development of the equipment covered a period of several years and it will be profitable to relate it from the beginning. Others may be interested in applying any of the stages in the development.

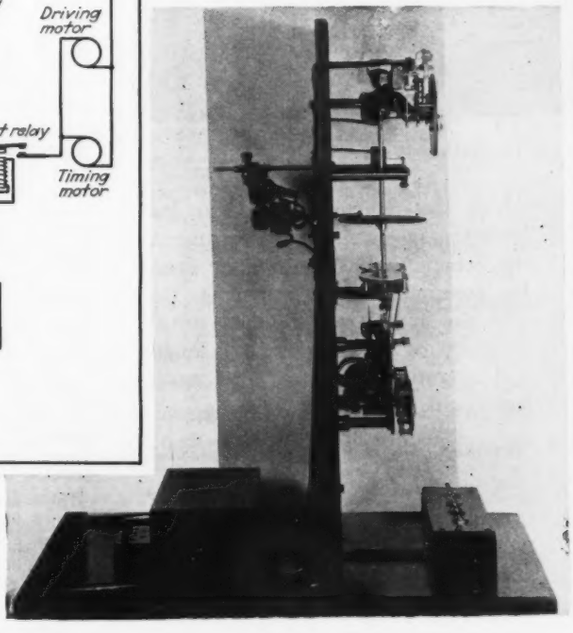
Over-all accuracy of a demand register is a combination of three sub-accuracies: First, the accuracy of the watt-hour meter element from which the register is operated; second, the accuracy of the operation of the demand-indicating mechanism; third, the accuracy of the timing element. Of these three accuracies, the first is determined by a meter test and the third can be found by checking the time interval with a stop watch, but the second is more difficult to obtain and requires some special equipment.

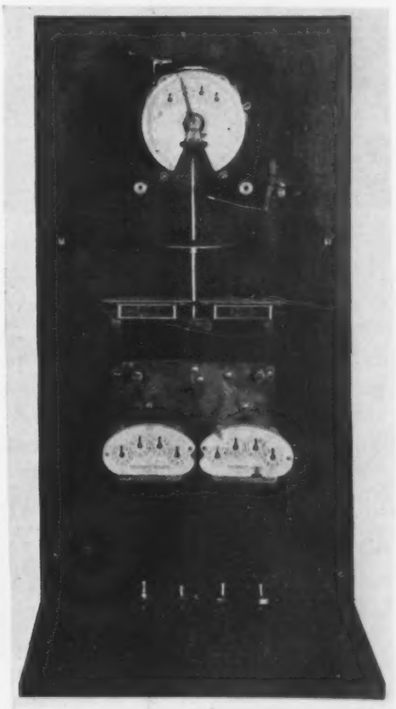
To obtain definite information on the operation of the demand-indicating mechanism a device was made some years ago to test the register only, after it had been removed from the meter. This first device consited of a small synchronous motor driving a vertical shaft which meshed with the register under test. A rubber-surfaced disk was mounted on the shaft and the driving motor suspended in such a way that a small fiber wheel on the end of the motor



Demand interval mechanism in the register starts, shifts and stops testing device so that two consecutive tests are made automatically and may be checked against each other.

Fig. 1—Automatic register testing device





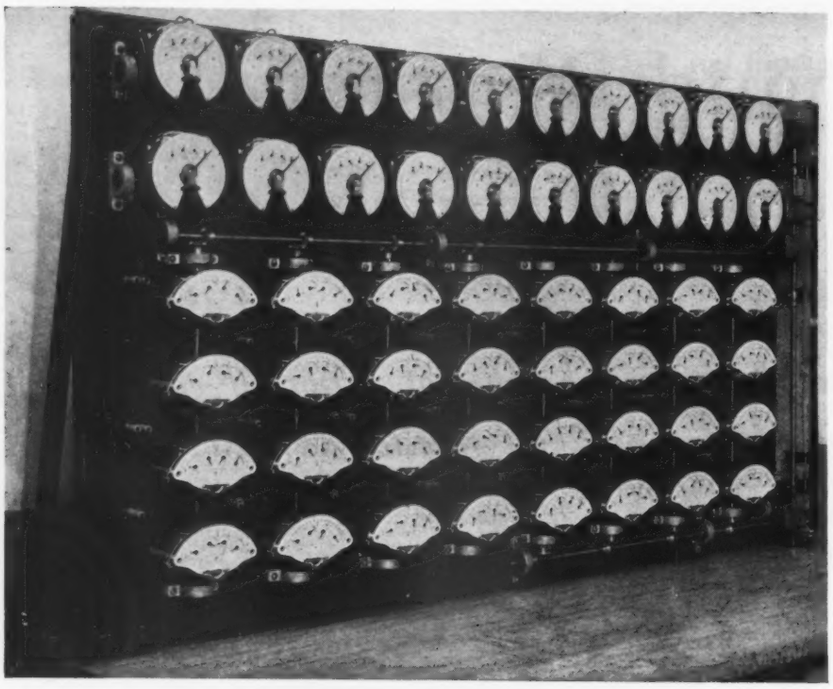


Fig. 2—Gang checker in one form

Registers are divided into four groups, two to each type, so that checks of different groups may be made at different drive speeds, making for smooth production flow.

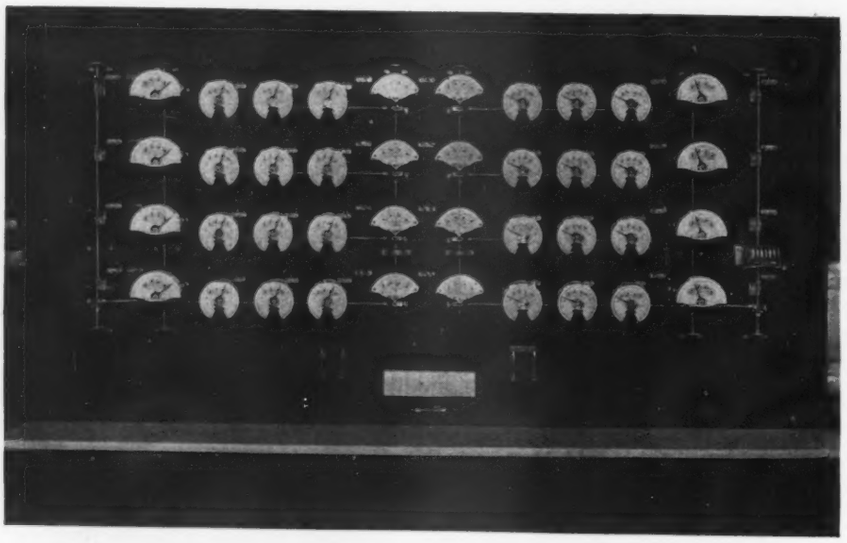


Fig. 3—Gang checker in another form

shaft bore on the rubber-surfaced disk at any desired radial point. A meter register was then geared to the perpendicular shaft to record the number of revolutions. With this arrangement any desired disk speed was obtainable, and by reading this "revolution counter" at the beginning and end of each time interval the exact number of revolutions of the shaft during that period was known. By multiplying this number of revolutions by the number of time intervals per hour and then by the disk constant of the meter from which the register under test had been removed the correct reading of the demand-indicating pointer could be computed. By comparing this with the actual reading the over-all accuracy of the pointer adjustment and operation of the resetting mechism could be checked.

Automatic register checker developed

Next development (Fig. 1) was one which overcame one of the weak points in the earlier equipment by doing away with the need for the operator to be on hand at the instant of the beginning of each time interval. This checker is automatically operated by the reset mechanism of the register under test which makes contacts at the end of each time interval. These contacts, through various settings of the switches at the base and in front of the checker, perform any predetermined function, such as starting or stopping or shifting from the right-hand set of registers to the left, thus ending one check and beginning another.

This checker was designed to test only two types of demand registers and to take two consecutive checks on each register, which are considered sufficient, unless results obtained indicate otherwise. Variable speed was obtained on this checker by the method employed on the earlier device.

The two lower registers are gear-driven by a synchronous motor and record the time interval in seconds, while the two upper registers are geared to the moving element, recording the revolutions during the interval of test. The two right-hand registers which are used in the first check are standard meter registers with the gears rearranged so that the drive sequence is from left to right instead of from right to left. The two left-hand registers which are used in the second check are standard in every respect.

Contact-making devices for both types of demand registers are shown in Fig. 1. The contacts for the type of register which in this illustration is mounted for test are at the upper left of the register and are held open by a resetting arm which is just inside the register and which moves to the right at the end of each time interval. The weight protruding to the left of the device then closes the contacts, which are opened a few seconds later by the arm returning to its normal position after the resetting operation is completed.

Device for making a contact at the end of each interval for the other type of demand register is shown below and to the right of the register. It consists of a balance which is so adjusted that a small vane on the arm extending out to the left is just inside of the arc of the lead weight in the register which performs the resetting operation and as nearly directly below it as practical, so that when the weight strikes the vane a minimum amount of momentum will be lost. This balance is of light construction and is accurately adjusted so that it cannot affect the normal operation of the register. Both of these contact devices are removable and are placed in position after the register is mounted on the checker.

There are two small synchronous motors on this checker, one driving the disk and the other recording the time in seconds. These motors are started and stopped by an electromagnetically operated switch

[*Continued on page 140*]

Commercial Cooking Loads Found Highly Satisfactory

E.A.R. per salesman averages $15,875 and costs only 33 cents per dollar

By S. L. CIPPERLY
Southern California Edison Company, Ltd., Los Angeles, Calif.

ALONG with the late depression and the reduction of revenue resulting, our company was also confronted with the approaching date when Boulder Dam power would be available in our area. One of the steps taken to meet these problems was a broad expansion of our new-business department with a view of instituting an aggressive sales campaign for all types of power load that would yield profitable revenue.

In scanning the field for classes of load that would be reasonably certain to show good returns under proper stimulation, we found that the commercial cooking field offered excellent possibilities and measured up well in our requirements for the type of business worthy of active promotion. These advantages are:

High load factor, producing more revenue per kilowatt connected than many other power loads.

Good diversity, as peak demands of commercial cooking load do not occur at the time of system peak demand. A substantial portion of the bakery load, for example, comes on between midnight and 6 a.m.

Low investment to serve. A substantial amount of this business, such as counter equipment, can be secured without any change in service facilities. Establishments using this type of load are usually centrally located in communities where ample facilities to serve are usually available.

Unity power factor. All commercial cooking equipment is straight resistance heating. The cost of serving this class of business is much lower than other power loads of lower power factor. It is an ideal load to serve, with a minimum of line disturbance.

Our first plan called for four full-time salesmen who were to work in co-operation with our 32 general power salesmen. The idea was to develop prospects through the power salesman, who would call on the commercial cooking salesmen for aid when necessary. No direct sales were contemplated under this plan as all business was to be sold through the restaurant equipment distributors or electrical dealers. A one week's course of instruction on sales and operation of equipment was held with the aid of the largest manufacturer in this field. The following subjects were handled during this school:

Layout and plans for commercial kitchen.
Layout and plans for commercial bakery.
Construction and design of equipment.
Methods of estimating operating cost.
Demonstration of equipment.
Details of kitchen operation.
Details of bakery operation.
Application of various rate schedules.
Market analysis.
Sales methods.

Change to direct selling

We believed we had worked out a good, practical promotional organization, but after one year's trial, during which we sold 1,100 kw., representing a revenue of $38,000, we changed our plan considerably as we were not satisfied with these results. Our first change was to direct merchandising of the equipment. This was necessary because at that time we were unable to get satisfactory co-operation from the restaurant equipment houses and we decided we would be better off on our own. Except in rare cases, the electrical dealers were unable to develop much of this business, for it requires salesmen who understand restaurant operation and equipment.

In conjunction with our direct selling campaign, we next planned on a larger sales force of men working full time on this activity. Salesmen with experience in the restaurant equipment business were given preference when obtainable. Compensation was on a straight salary basis, with automobile furnished or a mileage allowance in the case where the salesman used his personal car. As a survey of our territory indicated approximately 4,000 commercial cooking consumers, we continued to add salesmen until each man had an average of 500 to 600 accounts to look after.

One main point of sales resistance on heavy-duty equipment has always been the wiring cost. In view of the

S. L. Cipperly

fact that little or no similar expense is involved with competitive equipment, the prospect objects strenuously to this item, often to the extent of killing the sale. To overcome this, we offer a wiring allowance up to $4 per kilowatt of capacity of equipment installed. The equipment must be *bona fide* heavy-duty commercial cooking equipment. We specify this to discourage the use of domestic appliances, as they are not designed to stand this kind of service. An allowance on the cost of wiring is very essential to securing this load and will more than justify the expense involved in an over-all lower sales cost per kilowatt installed.

"Loaner" for emergencies

Good service on the equipment is necessary to the permanent success of a promotional campaign such as this. A restaurant or bakery could be seriously embarrassed should the equipment fail at the wrong time. To give the best service possible our entire service organization has been given several courses of instruction on commercial equipment. On the most commonly used apparatus such as fry kettles, broilers etc., a "loaner" is kept on hand at each division service shop to loan the consumer in the event repairs to his equipment cannot be made promptly.

Advertising plays an important part in our development of this business. Direct mail advertising pieces, mostly of the testimonial type, together with some special campaign offer, get the best results. This material is prepared by our own advertising department, but we also send out some of the material supplied by the various manufacturers. To obtain the maximum benefit from this advertising great care is taken to keep an accurate mailing list of all commercial cooking prospects in our territory, made up as follows: Restaurants, hotels, bakeries, hospitals, soda fountains and schools.

Traveling demonstrations

The problem of being able to display heavy-duty equipment so that a reasonable proportion of our prospects could see it was a difficult one for us, due to a large number of small towns spread over a considerable area. Our experience indicated that we could sell the equipment that our salesmen could carry with them and show to the prospect. As this was only possible with the smallest equipment, we put into service a large display coach or trailer (see ELECTRICAL WORLD, October 9, 1937, page 97) capable of carrying a complete line of commercial equipment, as follows:

Combination baking and roasting oven.
One section heavy-duty range.
Heavy-duty installation type fry kettle.
Heavy-duty stock kettle.
Hot food storage table.
Hot food storage cabinet.
Two counter fry kettles.
Automatic griddle.
Vertical and charcoal type broilers.
Waffle iron, toasters, etc.

Our method of handling this display is to assign it for a period of one week to one of our territory divisions. The division commercial cooking salesman and the driver-salesman permanently assigned to the display handle the exhibit for that week. On the first visit to a town the trailer is generally parked in a prominent central location. Invitations are mailed previously to all prospects in that vicinity announcing when and where the exhibit will be. Newspaper publicity on the exhibit is usually given also. With all this "build-up" we generally get a real turn-out of interested potential users. On return visits to the same community we take the exhibit to the various prospect's establishments. We endeavor to get the entire personnel of the place to see the exhibit as their opinions and ideas often help to sell the boss.

This display has been invaluable to us in creating interest in this field. The greater portion of our restaurant men had never seen and were not aware that such equipment existed.

At the beginning of our direct selling campaign we decided on concentrating on the sale of counter fry kettles (for French frying), as the operation of this equipment is highly satisfactory to the user over all other methods of deep frying. Our chief reason for starting with this item was our belief that it would serve to convince the restaurant man that at least some of his cooking operations could be done much better with electric heat, with a reasonable operating expense. With the idea of high op-

[*Continued on page 143*]

Commercial cooking exhibit used at convention of restaurant men at Los Angeles

This bakery was outstanding success from the day it opened. The owner states the electric story was most important factor

8th Appliance Sales Survey

LOAD BUILDING PROGRESS *in* 1937

Analysis of current trends of appliance sales by utilities and by dealers, of the effect on customer usage and revenue and an appraisal of results

By HENRY G. DOOLEY
Associate Editor

THIS year a large number of utility companies have made it possible, through their co-operation, to present here a wealth of detail as to the whole gamut of their load-building operations throughout 1937 in that most important of the basic sources of revenue—the residential field.

Pages of details follow, arranged for analysis by regions and by individual companies. Again this year the separation is maintained between companies which divide the direct appliance merchandising job with their dealers and those companies which only promote appliance merchandising, leaving the direct selling to their dealers. Results in 1937 of the promotional work by the latter group of companies is discussed on subsequent pages.

The great majority of utility companies find it necessary today both to promote and sell appliances, and a broad summary of their over-all results is given on this page. Dollar merchandise sales of these companies increased 7.89 per cent over 1936 and sales of their dealers increased 8.98 per cent. These figures are comparable, as they embrace only those companies which reported the respective volumes for both years. The acceleration in dealer sales comes in great part from the dealers' increased participation in the sale of major appliances as the data show the companies were selling 5 per cent more refrigerators, 4 per cent more ranges and 14 per cent more water heaters, but the dealers were increasing their sales by 11 per cent, 5 per cent and 62.8 per cent respectively.

Between them the utility and the dealer sold the customers a volume of appliances valued between 8 and 9 per cent more than in 1936, but reduced to a per customer basis, sold and unsold, the joint sales of $16.55 were up only 4 per cent.

Nevertheless, these companies saw average residential consumption and the average annual residential bill increase to the same degree as was reported in the latest January 15, 1938, annual statistical number of ELECTRICAL WORLD on pages 86 and 87 of that issue.

To complete the general picture, weighted averages, based naturally only upon those companies which reported complete data, show that total direct sales expense, advertising expense and promotion expense increased 2 per cent to gain a 9 per cent increase in usage and a 3 per cent increase in the annual residential bill. Such is a measure of the efficacy of the selling effort of utility companies, large or small, independents or affiliates which themselves did direct selling with or without dealer help.

LOAD BUILDING IN 1937

As reported by 118 Utility Companies serving 13,111,505 domestic customers

1	Companies increased merchandise sales volume	8%
2	Dealers in same territory increased merchandise sales volume . . .	9%
3	Sales per customer by utilities and dealers increased	4%
4	Average consumption went up .	9%
5	Average annual bill went up . .	3%
6	Sales and promotional expenses per customer went up	2%

Domestic Appliance Sales by Power Compani

Table I—Total sales of household appliances by 118 power companies during the full year 1937, together with estimates of dealer sales of refrigerators, ranges and water heaters in the same areas.

Company	Domestic Consumers Dec. 31	Average Annual Domestic Kw.-Hr. Consumption		Av. Rev. per Consumer	Av. Price, Cents per Kw.-Hr.	REFRIGERATORS					RANGES					WATER HEATERS				
						Units Sold By Power Cos.		Units Sold By Dealers Pwr. Co. Est.		Saturation %	Units Sold By Power Cos.		Units Sold By Dealers Pwr. Co. Est.		Saturation %	Units Sold By Power Cos.		Units Sold By Dealers Pwr. Co. Est.		Sa ra
	1937	1937	1936	1937	1937	1937	1936	1937	1936	1937	1937	1936	1937	1936	1937	1937	1936	1937	1936	19
I—NORTHEAST—North of the Ohio River, East of the Mississippi River																				
1	H 801,766	869	806	34.11	3.9	4,725	A 4,336	.....	.....	47	547	.....	.....	.....	B 0	0	0	.....	.....	
2	H 775,228	642	595	33.92	5.3	8,029	6,968	.....	.....	.....	276	237	.....	.....	.....	53	32	.....	.....	
3	* 625,000	774	690	32.79	4.2	0	0	52,000	45,069	40	12,433	10,018	6,182	2,580	11	3,896	3,294	1,392	679	
4	H 569,099	872	793	36.25	4.2	4,997	4,935	63,003	53,065	.....	4,658	6,064	1,918	1,378	.....	4,759	4,320	493	270	
5	557,369	901	823	32.41	3.6	3,525	2,705	.....	.....	53	10,063	9,949	5,449	1,146	10	1,174	719	15	14	
6	H 524,205	579	545	33.13	5.6	9,184	6,563	.....	.....	.....	3,733	3,332	.....	.....	.....	179	160	.....	.....	
7	338,439	692	664	35.80	5.2	4,538	3,710	.....	.....	.....	2,054	1,669	577	739	4	329	247	54	42	
8	H 334,937	1,004	849	32.54	3.2	11,393	11,808	.....	.....	49	6,911	7,648	13,141	9,007	19	2,928	2,000	1,703	790	
9	H 329,972	666	609	37.66	5.7	3,406	3,509	18,872	15,377	43	2,809	3,074	2,106	1,048	6	853	774	312	185	
10	H 300,033	914	842	37.61	4.1	2,001	2,083	33,000	31,070	58	9	5	126	120	1	.....	.....	.....	.....	
11	H 269,320	840	762	43.09	5.2	4,558	5,298	23,469	17,500	55	2,346	549	1,985	150	3	895	157	348	50	
12	H 245,497	902	842	35.93	4.0	3,889	2,760	.....	.....	.....	1,122	1,006	.....	.....	.....	273	206	.....	.....	
13	H 216,195	847	816	28.07	3.3	1,290	1,286	23,700	28,714	67	695	653	183	63	G 14	133	121	20	14	
14	212,344	913	823	29.64	3.3	1,286	1,148	12,214	8,852	31	1,121	1,044	1,649	1,236	6	560	598	420	322	
15	176,220	878	813	34.90	4.0	4,001	3,529	15,000	10,000	45	1,680	1,087	550	25	6	327	148	14	6	
16	171,764	1,007	866	34.76	3.5	6,665	6,604	.....	.....	40	3,358	4,337	2,310	999	14	1,742	1,105	276	49	
17	157,848	992	936	31.22	3.2	12,992	11,362	.....	.....	34	712	782	1,629	.....	8	10	.....	3	.....	
18	144,683	672	613	39.46	5.1	692	698	4,214	3,478	46	77	84	636	475	6	15	17	53	34	
19	H 140,944	913	821	44.11	4.8	5,744	4,836	6,000	4,500	50	1,884	1,858	550	450	10	1,059	841	225	150	
20	H 125,771	577	528	32.79	5.7	4,184	2,576	4,449	4,158	28	2,840	1,870	476	169	10	774	655	55	18	
21	117,029	693	639	34.37	5.0	1,754	2,462	11,166	11,926	.....	307	278	145	9	.....	177	152	44	4	
22	H 112,925	621	570	31.08	5.1	2,880	2,251	.....	.....	.....	1,130	1,106	.....	.....	.....	217	364	.....	.....	
23	107,767	773	688	34.46	4.5	724	694	.....	.....	.....	531	1,163	634	266	.....	651	585	105	46	
24	H 105,191	737	677	41.20	5.6	2,168	1,468	.....	.....	.....	38	9	.....	.....	.....	10	2	.....	.....	
25	H 98,590	713	649	38.86	5.5	200	182	8,547	6,499	41	204	124	1,877	1,497	8	185	152	675	572	
26	H 95,817	775	672	33.08	4.3	2,198	1,660	7,000	6,000	.....	1,419	1,040	.....	683	.....	37	17	.....	.....	
27	83,909	839	753	41.52	.....	6,342	5,852	3,300	2,750	65	1,581	439	50	10	3	28	24	0	0	
28	H 83,052	730	683	47.58	6.5	3,133	2,693	4,000	3,750	41	996	745	150	100	6	373	287	15	10	
29	H 79,797	708	671	34.79	4.9	2,375	1,836	5,500	5,000	54	181	113	50	10	2	10	9	0	.....	
30	73,790	845	765	42.44	5.0	1,135	1,021	6,283	5,782	49	968	898	865	536	10	825	807	249	82	
31	H 71,120	734	646	36.27	4.9	2,021	1,560	3,648	2,449	26	1,702	1,169	369	176	11	826	998	158	114	
32	H 71,076	691	629	34.89	5.1	519	387	.....	.....	.....	804	562	.....	.....	.....	62	14	.....	.....	
33	H 69,946	649	597	33.16	5.1	1,611	1,275	2,246	1,901	.....	1,203	1,024	146	67	.....	574	426	23	12	
34	H 67,674	691	628	36.91	5.4	1,295	941	.....	.....	.....	838	792	.....	.....	.....	622	618	.....	.....	
35	H 58,801	745	687	37.74	5.1	3,346	2,798	.....	.....	.....	1,339	1,166	.....	.....	.....	265	171	.....	.....	
36	H 57,888	638	572	34.18	5.4	1,563	1,455	2,043	1,414	31	956	895	537	334	10	357	133	39	4	
37	H 56,338	939	860	34.91	3.7	1,820	2,360	.....	.....	4 8	1,133	984	79	29	7	391	228	32	19	
38	H 54,364	673	623	37.99	5.6	1,053	856	4,000	3,500	40	615	391	250	150	12	46	47	.....	.....	
39	H 52,745	727	649	38.14	5.1	1,268	1,272	4,473	3,437	42	701	572	156	117	6	441	375	67	61	
40	H 47,481	557	494	29.54	5.3	988	880	.....	.....	40	580	487	.....	.....	7	171	191	.....	.....	
41	H 43,446	489	453	31.12	6.4	1,266	1,117	2,086	1,435	36	110	105	29	25	2	6	17	0	0	
42	H 43,100	784	732	41.50	5.3	48	50	2,205	2,473	44	103	57	949	1,160	17	66	36	237	267	
43	40,851	855	748	35.28	.....	2,199	1,866	.....	465	45	826	859	212	43	8	259	126	38	2	
44	40,469	726	687	43.01	6.0	1,131	1,286	2,898	2,820	66	201	250	133	112	10	4	6	.....	.....	
45	35,688	753	698	35.01	4.7	295	294	2,401	2,081	37	513	613	398	347	18	222	117	35	16	
46	H 35,116	667	577	31.89	4.8	1,568	1,678	1,725	1,500	.....	836	698	287	90	.....	282	208	73	15	
47	H 33,598	654	608	44.76	6.8	388	320	1,100	1,000	.....	99	94	50	20	.....	30	33	6	2	
48	32,593	864	787	42.51	4.9	842	597	4,000	3,500	50	111	105	125	45	5	19	16	2	3	
49	H 31,533	515	485	30.34	5.9	231	170	150	100	25	42	52	45	35	1	7	5	4	.....	
50	H 29,912	761	698	32.43	4.3	722	742	.....	.....	33	515	345	85	54	5	173	46	.....	.....	
51	24,934	784	724	38.54	4.9	408	250	2,100	1,700	50	266	125	127	58	8	29	23	11	5	
52	H 22,508	743	673	33.88	4.6	604	659	2,114	2,324	75	50	16	10	7	.....	1	0	0	0	
53	20,357	2,144	1,982	43.40	2.0	2,588	2,024	.....	.....	60	53	42	1,997	1,582	45	102	64	.....	.....	
54	19,942	705	655	31.40	4.2	35	59	3,700	3,000	.....	63	113	897	410	.....	24	19	198	64	
55	H 16,090	615	574	32.78	5.3	305	392	756	521	30	247	211	100	66	11	95	26	9	0	
56	13,798	657	587	34.45	5.2	260	213	1,180	744	45	16	10	10	3	2	.....	.....	.....	.....	
57	13,212	628	564	34.95	5.4	185	124	553	373	21	281	248	98	88	13	118	64	20	18	
58	9,634	1,173	1,046	34.01	2.9	646	480	.....	.....	44	284	282	290	203	26	14	18	.....	.....	
59	H 8,248	654	584	33.66	5.1	79	77	382	227	24	100	126	15	16	12	69	49	3	6	
Total..	9,096,963	F 781	F 712	F 35.90	F 4.8	149,292	133,015	345,477	300,454	F 44	81,270	73,574	50,632	27,933	F 9	27,747	21,867	7,426	3,945	
II—SOUTHEAST—South of Ohio River, East of Mississippi River																				
60	H 158,003	1,313	1,183	39.86	3.0	9,258	7,123	1,799	1,729	66	6,476	6,646	332	159	22	4,106	3,965	179	53	
61	117,580	1,353	1,176	38.66	2.9	5,080	7,708	.....	.....	58	3,542	5,064	.....	1,794	26	2,240	2,801	.....	449	
62	117,112	1,076	1,004	41.42	3.9	.....	.....	15,311	13,842	61	1,790	1,316	1,354	951	14	643	517	78	95	
63	H 107,650	1,205	1,121	38.01	3.2	4,977	7,085	.....	.....	61	3,396	3,411	1,896	947	22	1,812	1,804	898	286	
64	H 97,421	1,102	1,016	58.21	5.3	194	333	16,014	17,192	50	600	927	4,445	3,965	20	419	573	2,197	1,999	
65	75,833	1,121	1,010	39.37	3.4	635	1,241	11,946	8,038	57	1,523	1,775	2,507	1,011	21	873	993	733	277	
66	H 73,450	934	905	43.48	4.7	2,085	3,020	5,754	5,852	63	623	730	476	409	15	360	133	56	16	
67	71,338	639	599	F 32.81	5.1	1,187	1,272	6,109	4,939	39	1,007	940	466	241	8	391	306	68	55	
68	60,452	760	684	28.43	3.7	137	484	8,841	7,522	53	297	77	356	150	3	61	6	71	25	
69	H 37,273	847	782	44.69	5.3	401	424	4,656	4,063	.....	191	302	330	199	.....	89	108	71	56	
70	32,401	676	628	41.15	6.1	746	737	826	660	36	621	575	104	45	11	347	335	.....	.....	
71	31,284	835	758	36.99	4.4	1,860	1,807	.....	.....	45	662	376	27	.....	12	517	269	24	.....	
72	25,457	920	836	47.25	4.0	780	940	1,439	1,096	48	544	497	284	170	13	1,635	531	280	154	
73	H 29,130	633	596	33.38	5.0	427	467	2,301	2,368	45	296	275	176	144	8	26	13	15	6	
74	H 20,221	1,212	1,072	43.20	3.6	1,038	955	271	.....	52	428	456	127	.....	18	298	317	54	.....	
75	16,872	996	930	40.98	4.1	300	223	1,700	1,200	56	326	346	84	32	17	202	162	12	3	
76	H 15,971	892	819	37.08	4.0	562	643	2,034	1,357	67	152	140	172	169	8	50	54	37	39	
77	H 12,527	1,177	991	46.17	.....	558	805	1,049	745	58	426	509	151	70	20	310	367	61	43	
78	H 11,795	1,079	968	52.16	4.8	115	126	1,273	1,035	73	126	103	524	225	25	135	53	403	127	
Total..	1,111,770	F 987	F 898	F 41.20	F 4.2	30,340	35,393	81,323	71,638	F 55	23,026	24,465	13,811	10,681	F 16	14,514	13,307	5,237	3,683	

* Estimated. A Includes water coolers. B Started range sales in 1937. D Net sales shown, compared to gross in previous reports. E Ranges and water heaters
F Excludes home lighting specialists. G Rental purchase plan. H Company has gas customers. I Combined with gas expense. J Includes dealers' sales. K Includes

ıd Local Dealers for the Full Year 1937

Also, comparisons of these sales totals with the year 1936, with data on average consumption, rates, revenues, saturations, sales totals, sales people and direct sales and promotional expense in building domestic load — embracing over twelve million consumers.

Washing Machines Units Sold by Power Cos.		Sat. Wash. Mch. %	Ironing Machines Units Sold by Power Cos.		Saturation Ironing Machines, %	Vacuum Cleaners Units Sold by Power Cos.		Saturation Vacuum Cleaners, %	Total Sales of All Appliances By Power Cos. (Dollars)		Total Sales of All Appliances By Dealers (Dollars)		Power Co. Sales Per Consumer ($)	Annual Rev. Inc. from Power Co. Sales (Dollars)	No. Power Co. Salesmen and Women Building Domestic Load		Consumers Per Sales Person	Power Co. Direct Sales Expense ($)	Power Co. Advtg. & Promotion Exp. ($)	Sales & Adv. Exp. Per Consumer ($)	Company
37	1936	1937	1937	1936	1937	1937	1936	1937	1937	1936	1937	1936	1937	1937	1937	1936	1937	1937	1937	1937	
I—NORTHEAST—North of the Ohio River, East of the Mississippi River																					
953	3,525	60	1,061	1,006	6	6,817	5,167	80	D 4,072,352	D 3,729,597			5.08		652	625	1,230	1,928,043	529,174	3.06	1
368	11,431	.....	2,227	2,538	.....	6,598	6,601	.....	4,443,371	3,944,448			5.72		402	363	1,930	.....	.....	.....	2
0	0	.....	0	0	.....	0	0	.....	1,902,974	1,696,619			3.04	E 653,160	225	200	3,780	.....	214,205	0.34	3
101	3,335	.....	536	765	.....	1,115	1,399	.....	2,538,359	2,286,119			4.46	E 641,400	F 274	F 241	2,075	.....	.....	.....	4
0	51	.....	260	296	.....	0	378	.....	2,156,000	1,857,000			3.87	.....	69	66	8,075	.....	614,000	1.10	5
595	4,820	.....	961	1,046	.....	3,786	3,158	.....	3,069,000	2,576,000			5.85	.....	190	180	2,755	.....	.....	.....	6
135	2,167	.....	437	449	.....	1,991	2,578	.....	1,538,646	1,472,357			4.53	.....	57	49	5,930	.....	.....	.....	7
022	4,116	.....	1,309	1,283	.....	3,253	3,033	.....	4,048,951	3,615,426			12.12	.....	541	482	619	.....	.....	.....	8
984	3,199	86	416	536	1	1,436	1,358	61	1,653,978	1,746,978	$7,862,717	$6,356,194	5.01	255,644	450	421	733	792,376	157,485	2.88	9
009	2,257	65	413	892	17	1,939	1,790	68	1,193,685	1,199,724			3.97	191,805	48	44	6,250	152,730	16,965	0.57	10
844	2,219	75	524	614	10	1,892	2,189	85	1,916,730	1,585,389			7.12	300,000	188	100	1,430	.....	150,000	0.56	11
028	2,978	.....	317	315	.....	2,938	2,376	.....	1,932,095	1,521,707			7.88	.....	220	213	1,130	.....	.....	.....	12
972	1,044	60	245	281	5	2,178	2,517	55	795,837	807,067	10,000,000	11,400,000	3.68	57,000	113	107	1,910	.....	.....	.....	13
003	1,083	75	.....	90	5	1,581	1,715	65	976,630	859,883	.....	.....	4.59	.....	75	65	2,830	.....	.....	.....	14
411	1,334	88	447	445	5	1,100	1,352	.....	1,555,000	1,289,000	.....	.....	8.82	195,000	140	139	1,260	.....	.....	.....	15
321	3,019	.....	1,264	1,153	.....	1,689	1,922	.....	2,500,859	2,630,449	.....	.....	14.56	.....	289	254	595	.....	.....	.....	16
														175,974	69	71	2,290	.....	.....	.....	17
10	35	.....	5	2	.....	.....	.....	.....	208,853	215,700	.....	.....	1.45	J 144,683	.....	.....	.....	41,435	19,555	0.24	18
346	1,153	74	319	371	12	609	528	82	2,190,304	1,828,713	.....	.....	15.53	.....	148	152	952	560,698	80,227	4.55	19
648	578	.....	81	124	.....	600	.....	.....	1,520,848	1,128,454	.....	.....	12.10	177,139	167	118	752	.....	.....	.....	20
343	399	.....	31	55	.....	178	679	.....	486,619	575,856	.....	.....	4.15	105,814	59	65	1,985	.....	.....	.....	21
125	766	.....	114	92	.....	641	799	.....	1,201,312	909,561	.....	.....	10.68	117,709	90	85	1,254	.....	.....	.....	22
218	221	.....	57	44	.....	1,033	1,079	.....	400,013	444,016	.....	.....	3.71	88,985	26	25	4,140	.....	.....	.....	23
427	266	.....	187	88	.....	.....	260	.....	481,875	320,007	F 320,000	F 210,000	4.58	.....	25	24	4,200	.....	.....	.....	24
57	48	51	53	26	4	.....	.....	.....	125,047	113,036	2,761,185	2,355,532	1.27	25,032	18	21	5,470	235,000	34,649	2.73	25
318	285	.....	213	114	.....	448	153	.....	1,063,733	655,070	.....	.....	11.10	.....	146	133	655	.....	L 58,717	0.61	26
072	1,537	80	418	522	15	1,080	1,537	60	2,078,349	1,842,857	1,250,000	1,000,000	24.78	.....	178	160	471	0	61,000	0.73	27
824	769	44	262	187	3	795	806	63	986,711	817,397	.....	.....	11.88	243,136	48	44	1,729	(I)	(I)	.....	28
160	1,092	75	254	184	3	520	627	64	922,760	678,416	3,000,000	2,000,000	11.54	118,995	101	88	790	10,546	37,318	0.60	29
141	149	.....	51	47	.....	.....	.....	.....	411,384	430,273	.....	.....	5.57	91,966	41	41	1,800	143,384	36,926	2.42	30
367	474	.....	143	180	.....	.....	.....	.....	898,796	688,988	.....	.....	12.65	132,148	131	104	542	166,868	79,653	3.47	31
141	181	.....	27	46	.....	171	165	.....	290,985	217,005	.....	.....	4.08	50,000	20	12	3,552	.....	.....	.....	32
178	1,462	.....	267	233	.....	.....	.....	.....	799,059	664,369	.....	.....	11.43	137,272	44	44	1,590	182,670	48,021	3.30	33
463	473	.....	104	82	.....	1,342	1,567	.....	520,000	415,000	1,372,000	1,155,000	7.67	75,000	44	44	1,537	161,000	23,654	2.73	34
301	1,241	.....	123	115	.....	229	432	.....	1,225,326	993,439	.....	.....	20.80	.....	57	55	1,031	.....	.....	.....	35
098	892	.....	433	336	.....	.....	.....	.....	674,109	564,793	.....	.....	11.65	66,129	37	37	1,564	187,783	67,200	4.40	36
848	1,194	.....	149	228	.....	708	722	.....	743,352	788,828	.....	.....	13.20	.....	34	31	1,655	.....	.....	.....	37
			57	91	3				231,872	168,650			4.27	53,000				47,043	38,727	1.57	38
156	177	89	53	41	6	0	0	91	313,580	394,064	1,370,695	1,070,908	5.93	72,965	31	36	1,700	142,122	20,904	3.09	39
481	306	60	67	42	0	297	368	45	377,000	306,874	.....	.....	7.93	43,000	38	38	1,250	.....	.....	.....	40
248	332	60	69	143	2	141	189	60	385,415	340,610	.....	.....	8.87	48,386	60	60	723	.....	.....	.....	41
19	11	.....	4	3	.....	.....	.....	.....	J 177,382	J 171,168	.....	.....	J 4.11	35,168	8	9	5,380	85,706	6,978	2.15	42
852	1,210	.....	441	355	.....	548	464	.....	717,471	628,769	.....	.....	17.53	.....	63	66	648	.....	.....	.....	43
96	57	30	9	14	6	196	235	62	256,085	247,744	581,696	525,246	6.33	40,895	30	29	1,350	22,747	16,552	0.97	44
236	225	.....	20	33	.....	342	299	.....	239,114	184,998	.....	.....	6.71	39,000	20	19	1,785	55,190	51,006	2.97	45
405	544	.....	50	29	.....	987	907	.....	527,000	490,000	.....	.....	15.01	71,511	25	20	1,405	K 89,456	12,520	2.91	46
272	281	.....	67	82	.....	161	101	.....	149,571	119,335	.....	.....	4.45	27,438	13	11	2,580	34,088	83,054	3.49	47
744	739	65	135	128	5	612	545	65	460,008	379,400	1,200,000	900,000	14.11	.....	29	29	1,123	.....	.....	.....	48
441	448	50	16	23	2	457	282	45	152,522	121,196	165,128	121,585	4.83	28,087	16	16	1,968	28,679	12,253	1.30	49
323	497	.....	46	97	.....	325	483	.....	296,995	296,434	.....	.....	9.90	.....	38	45	788	.....	.....	.....	50
131	138	78	26	11	2	50	175	65	142,793	96,275	.....	.....	5.72	24,409	12	8	2,080	28,750	8,500	1.49	51
346	463	92	32	26	3	316	261	87	337,617	273,492	.....	.....	14.97	.....	14	14	1,605	(M)	19,106	0.85	52
														56,782	14	14	1,452	.....	.....	.....	53
	20						0								12	3	1,660	.....	.....	.....	54
320	222	.....	0	0	.....	.....	.....	.....	163,954	142,796	.....	.....	10.20	15,319	15	12	1,072	54,164	9,340	3.95	55
0	0	80	48	98	10	0	0	75	70,300	58,300	.....	.....	5.10	40,000	5	5	2,760	.....	.....	.....	56
118	114	.....	55	48	.....	.....	.....	.....	110,386	90,277	.....	.....	8.37	17,917	11	9	1,200	25,812	3,435	2.21	57
														16,784	9	9	1,070	.....	.....	.....	58
32	32	.....	16	20	.....	.....	.....	.....	47,672	43,801	.....	.....	5.78	7,607	12	12	687	26,826	4,776	3.83	59
651	65,609	Y 70	15,167	16,116	Y 6	51,099	51,196	Y 67	58,680,639	51,663,724	29,883,421	27,094,465	Y 6.10	4,682,259	5,891	5,367	Z 1,491	5,203,116	2,515,900	Z 2.52	Total
II—SOUTHEAST—South of Ohio River, East of Mississippi River																					
871	1,413	.....	377	329	.....	933	1,098	.....	3,287,207	3,113,741	.....	.....	20.80	.....	195	228	811	.....	.....	.....	60
953	1,001	.....	90	180	.....	318	654	.....	1,861,346	2,455,772	.....	.....	15.85	.....	145	175	810	.....	.....	.....	61
77	69	.....	11	11	.....	159	68	.....	.....	.....	.....	.....	.....	103,000	39	40	3,000	.....	.....	.....	62
063	1,083	.....	154	130	.....	140	174	.....	1,534,663	1,728,672	.....	.....	14.25	.....	69	76	1,560	.....	.....	.....	63
84	100	.....	22	34	.....	64	74	.....	248,070	322,190	5,116,782	4,871,949	2.56	54,246	61	68	1,597	178,000	50,800	2.36	64
20	55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
67	145	40	8	8	.....	28	80	.....	709,846	790,536	4,485,106	2,856,392	9.37	130,397	64	70	1,184	152,000	57,269	2.76	65
431	483	.....	97	17	.....	.....	.....	.....	405,949	701,421	.....	.....	5.53	85,000	33	35	2,226	90,159	13,509	1.41	66
68	48	20	7	5	2	55	184	35	627,766	600,419	.....	.....	8.80	.....	86	79	828	.....	.....	.....	67
134	149	.....	38	37	.....	168	187	.....	218,813	286,993	3,331,000	3,030,000	3.62	37,662	34	42	1,780	113,924	45,451	2.64	68
53	58	.....	9	9	.....	35	29	.....	198,258	224,899	1,737,051	1,374,410	5.32	51,740	30	37	1,242	.....	.....	.....	69
212	200	.....	24	32	.....	86	66	.....	291,309	258,170	.....	.....	8.98	73,801	19	19	1,705	.....	.....	.....	70
1	7	.....	.....	.....	.....	.....	.....	.....	538,222	499,855	.....	.....	17.22	.....	13	13	2,405	.....	.....	.....	71
43	35	+1	6	6	3	.....	.....	.....	344,703	256,510	1,250,000	1,000,000	13.50	J 209,958	12	12	2,120	69,400	N 118,000	7.34	72
209	132	.....	31	22	.....	152	169	.....	161,776	134,656	500,000	450,000	5.54	24,851	10	9	2,913	35,000	10,000	1.55	73
									334,710	343,706	.....	.....	16.54	.....	19	17	1,064	.....	.....	.....	74
7	8	.....	0	0	.....	23	19	.....	O 170,813	O 116,967	.....	.....	10.12	J 75,000	9	8	1,875	.....	.....	.....	75
18	8	.....	0	0	.....	2	6	.....	135,946	138,572	.....	.....	8.52	18,617	8	9	1,995	32,921	10,663	2.72	76
161	206	.....	29	23	.....	79	55	.....	246,604	312,366	.....	.....	19.70	.....	12	13	1,044	.....	.....	.....	77
9	4	.....	0	2	.....	10	10	.....	57,368	58,708	438,506	297,944	4.86	J 83,528	15	15	787	60,500	10,000	5.97	78
481	5,204	Y 34	903	845	Y 3	2,252	2,873	Y 35	11,373,369	12,344,153	16,858,445	13,880,695	Y 11.44	947,800	873	965	Z 1,273	731,904	315,692	Z 2.69	Total

heaters ... Includes ... ter heating expense. L All advertising. M Appliance profit covers all costs. N Includes free wiring. O Includes commercial sales. P Decrease due to rate reduction. ncluding run... S Total domestic annual revenue increase. Y Straight-line average. Z Weighted average, eliminating companies not reporting these items.

Domestic Appliance Sales by Power Companies

Table I—Total sales of household appliances by 118 power companies during the full year 1937, together with estimates of dealer sales of refrigerators, ranges and water heaters in the same areas.

Company	Domestic Consumers Dec. 31	Average Annual Domestic Kw.-Hr. Consumption		Av. Rev. per Consumer	Av. Price, Cents per Kw.-Hr.	REFRIGERATORS					RANGES					WATER HEATERS				Washing Machines
						Units Sold By Power Cos.		Units Sold By Dealers Pwr. Co. Est.		Saturation %	Units Sold By Power Cos.		Units Sold By Dealers Pwr. Co. Est.		Saturation %	Units Sold By Power Cos.		Units Sold By Dealers Pwr. Co. Est.		Units Sold by Power
	1937	1937	1936	1937	1937	1937	1936	1937	1936	1937	1937	1936	1937	1936	1937	1937	1936	1937	1936	1937
III—CENTRAL—West of Mississippi River, East of Rocky Mountains																				
79	H 317,415	909	804	35.75	3.9	3,560	4,015	20,000	19,275	40	4,552	4,282	4,127	2,733	11	2,703	2,901	1,946	1,190	652
80	H 258,448	983	937	.....	.....	1,827	1,481	37,300	39,666	73	1,687	1,560	3,132	2,941	5	.....	.....	.....	.....	.....
81	106,387	800	731	32.96	4.1	1,229	1,206	18,838	13,361	50	67	58	55	12	2	7	14	0	1	32
82	H 86,134	552	518	34.03	6.2	1,287	892	4,793	4,521	.....	0	0	0	0	.....	0	0	0	0	634
83	H 60,853	612	547	33.61	5.6	1,065	811	.....	.....	30	754	656	.....	.....	12	611	507	.....	.....	116
84	71,121	884	831	36.61	4.1	374	640	7,356	6,484	65	162	211	268	82	6	113	67	58	16	218
85	56,698	732	695	39.95	5.3	1,355	1,442	5,618	5,598	47	698	644	74	34	0	296	214	6	1	983
86	H 55,774	676	648	39.69	5.9	1,390	1,430	6,429	7,383	40	269	226	74	57	55	76	51	9	6	177
87	45,672	972	868	44.02	4.5	1,820	2,009	5,368	3,850	57	1,354	1,547	102	.....	13	661	620	15	.....	102
88	45,366	835	788	45.22	5.4	2,808	2,253	1,939	1,582	50	1,192	969	21	17	12	377	390	4	3	824
89	H 42,305	569	521	32.49	5.7	1,189	1,451	1,000	.....	30	839	793	100	.....	9	105	74	10	.....	359
90	H 40,035	701	655	34.77	5.0	1,106	984	1,449	1,667	21	431	163	46	28	6	307	245	3	4	220
91	H 36,208	898	852	43.90	4.9	1,737	1,778	1,494	1,397	.....	595	397	14	21	.....	471	385	1	6	610
92	H 27,490	577	557	35.89	6.2	524	393	2,623	2,071	37	66	64	149	84	5	59	55	51	29	560
93	26,232	820	750	34.10	4.2	504	705	600	600	24	634	1,016	50	50	21	325	371	5	5	87
94	H 23,885	702	644	36.40	5.2	819	571	2,005	2,202	48	582	474	65	57	8	58	93	7	8	247
95	23,473	765	699	39.21	5.1	396	516	1,539	1,665	42	455	572	151	61	11	152	223	13	6	107
96	20,241	1,006	913	38.38	3.8	653	391	1,605	833	54	714	587	10	11	17	458	502	11	12	132
97	19,419	777	746	36.05	4.8	1,202	1,115	.....	.....	.....	204	179	.....	.....	.....	11	18	.....	.....	145
98	18,749	700	666	36.32	5.2	895	858	313	534	45	384	336	4	15	14	23	12	.....	.....	288
99	17,324	589	543	33.92	5.8	231	180	1,097	1,073	41	180	165	32	23	12	32	27	8	1	164
100	9,459	705	634	38.16	5.4	202	119	841	901	49	213	224	63	46	13	163	140	33	15	41
101	H 9,315	662	626	33.16	5.0	311	350	587	588	.....	84	119	5	2	.....	30	25	2	.....	46
102	8,434	618	594	31.88	5.2	163	108	.....	.....	.....	167	114	.....	.....	.....	80	70	.....	.....	36
103	H 6,125	672	612	39.00	5.0	134	131	120	80	21	6	4	.....	.....	3	.....	.....	.....	.....	73
104	* 3,600	877	828	39.25	4.5	60	37	275	250	46	91	123	4	.....	14	25	23	0	0	.....
Total..	1,436,162	F 753	F 700	F 37.00	F 5.0	26,841	25,866	123,189	115,581	F 43	16,380	15,483	8,546	6,274	F 12	7,143	7,027	2,182	1,303	6,853
IV—WESTERN—Rocky Mountains to Pacific Coast																				
105	H 577,960	849	781	30.47	3.6	.....	.....	49,083	47,128	4	1,584	1,829	2,740	2,404	7	1,136	1,578	1,402	997	.....
106	H 157,847	1,202	1,121	33.73	2.8	1,192	1,288	10,022	8,430	28	2,891	2,927	1,335	1,024	26	1,635	1,678	583	462	0
107	H 108,422	611	570	34.34	5.6	1,847	2,230	.....	.....	45	772	584	.....	.....	1	85	36	.....	.....	1,038
108	102,757	1,286	1,160	35.64	2.8	661	768	7,000	7,500	40	1,328	1,763	2,425	2,240	25	1,454	1,431	130	100	205
109	99,673	940	876	36.84	3.9	1,360	1,919	9,440	9,170	50	2,310	2,348	2,417	1,205	33	1,268	912	368	68	337
110	H 85,741	1,187	1,100	40.00	3.4	506	676	8,439	9,621	75	0	0	1,961	1,803	14	0	0	1,050	951	99
111	H 70,967	835	733	31.51	3.8	440	333	8,185	8,452	55	472	515	328	205	6	455	565	178	134	228
112	H 65,228	815	781	36.04	4.4	1,415	1,623	5,751	6,100	.....	922	1,027	158	85	20	81	40	.....	.....	215
113	58,817	1,879	1,775	42.17	2.2	248	412	7,549	7,128	44	1,043	1,424	1,112	776	29	1,369	1,278	468	181	213
114	46,599	1,577	1,396	47.55	3.0	677	721	4,941	5,144	45	2,011	2,162	2,552	2,216	50	1,756	2,223	532	295	422
115	41,040	1,475	1,382	39.26	2.7	751	736	6,038	5,271	33	999	1,101	680	490	18	834	488	230	52	925
116	Q 25,521	Q 1,944	Q 1,821	Q 46.90	Q 2.4	923	818	.....	.....	.....	1,675	1,933	.....	.....	40	886	664	.....	.....	261
117	22,288	748	682	37.56	5.0	371	466	2,000	1,850	30	329	313	50	35	20	158	202	7	0	110
118	* 3,750	999	933	35.15	3.5	9	7	.....	.....	.....	88	65	5	8	.....	24	24	.....	.....	.....
Total..	1,466,610	F 1,168	F 1,080	F 37.60	F 3.5	10,400	11,997	118,448	115,794	F 41	16,424	17,991	15,763	12,491	F 22	11,141	11,119	4,948	3,240	5,033

* Estimated. A Includes water coolers. B Started range sales in 1937. D Net sales shown, compared to gross in previous reports. E Ranges and water heaters
F Excludes home lighting specialists. G Rental purchase plan. H Company has gas customers. I Combined with gas expense. J Includes dealers' sales. K Includes

Table II—Regional Summary and Comparison

Some general reflections of local conditions and the sales activity of the power companies in the four major areas of the country.

Region	Total Domestic Consumers Dec. 31, 1937	Av. Dom. Kw.-Hr. Consumption 1937	Kw.-Hr. Increase Over Dec. 31, 1936	Av. Cost of Dom. Service Cents per Kw.-Hr. 1937	Av. Revenue per Consumer 1937	Refrigerators Units Sold by Power Cos. 1937	Ranges Units Sold by Power Cos. 1937	Water Heaters Units Sold by Power Cos. 1937	Washing Machines Units Sold by Power Cos. 1937	Ironing Machines Units Sold by Power Cos. 1937	Vacuum Cleaners Units Sold by Power Cos. 1937	Refrigerators Sold per 1,000 Consumers 1937	Ranges Sold per 1,000 Consumers 1937	Water Heaters Sold per 1,000 Consumers 1937	Washing Machines Sold per 1,000 Consumers 1937	Ironing Machines Sold per 1,000 Consumers 1937
Northeast	9,096,963	781	69	4.8	$35.90	149,292	81,270	27,747	59,651	15,167	51,099	16	9	3		2
Southeast	1,111,770	987	89	4.2	41.20	30,340	23,026	14,514	5,481	903	2,252	28	21	13		1
Central	1,436,162	753	53	5.0	37.00	26,841	16,380	7,143	6,853	1,117	5,728	19	11	5		1
Western	1,466,610	1,168	88	3.5	37.60	10,400	16,424	11,141	4,053	1,182	3,036	7	11	8		1
Nat'l Total or Average	13,111,505	855	72	4.6	37.20	216,873	137,100	60,545	76,038	18,369	62,115	17	10	5		1

...and Local Dealers for the Full Year 1937

Also, comparisons of these sales totals with the year 1936, with data on average consumption, rates, revenues, saturations, sales totals, sales people and direct sales and promotional expense in building domestic load — embracing over twelve million consumers.

Washing Machines: Units Sold by Power Cos.	Washing Machines: Sat. Wash. Mch. %	Ironing Machines Units Sold by Power Cos.	Saturation Ironing Machines, %	Vacuum Cleaners Units Sold by Power Cos.	Saturation Vacuum Cleaners, %	Total Sales of All Appliances By Power Cos. (Dollars)	Total Sales of All Appliances By Dealers (Dollars)	Power Co. Sales Per Consumer ($)	Annual Rev. Inc. from Power Co. Sales (Dollars)	No. Power Co. Salesmen and Women Building Domestic Load	Consumers Per Sales Person	Power Co. Direct Sales Expense ($)	Power Co. Advtg. & Promotion Exp ($)	Sales & Adv. Exp. Per Consumer ($)	Company
1937 | 1936	1937	1937 | 1936	1937	1937 | 1936	1937	1937 | 1936	1937	1937 | 1936	1937	1937	1937	1937	1937	
III—CENTRAL—West of Mississippi River, East of Rocky Mountains															
652 | 782	75	243 | 218	12	1,673 | 1,754	72	1,800,000 | 1,745,000	$6,700,000 | $6,400,000	5.66	326,000	215 | 199	1,476	535,000	155,000	2.18	79
										130 | 116	1,988				80
32 | 28	20	5 | 5	2	532 | 510	30	481,834 | 469,814	5,592,143 | 4,320,975	4.52	67,460	78 | 76	1,364	168,148	109,935	2.61	81
634 | 547		48 | 22		369 | 361		442,967 | 421,928	2,743,629 | 2,834,029	5.15	127,762	56 | 56	1,537	169,321	80,765	2.90	82
116 | 66	62	32 | 24	2	124 | 9	44	450,000 | 364,000		7.38	102,800	40 | 32	1,520	83,000	40,000	2.02	83
218 | 411		77 | 117		484 | 1,154		306,000 | 414,800	3,315,000 | 2,895,500	4.30	26,900	54 | 50	1,320				84
983 | 822		125 | 154		252 | 256		514,521 | 451,946		9.07	63,116	40 | 27	1,420	130,599	28,917	2.82	85
177 | 289	32			102 | 132	65	494,180 | 493,021		8.86	57,487	56 | 52	996	108,444	60,635	3.03	86
102 | 167		4 | 6		92 | 138		620,478 | 643,633		13.60	94,376	60 | 60	760	136,900	30,462	3.66	87
824 | 773		171 | 195		237 | 257		841,892 | 701,649		18.55	134,008	69 | 60	658	203,138	93,124	6.53	88
359 | 423		28 | 38		419 | 454		350,000 | 370,000		8.27	50,000	28 | 26	1,512	79,000	25,000	2.45	89
220 | 243	70	29 | 46		449 | 361	50	441,138 | 393,000		11.01	50,486	44 | 40	908		25,000	0.62	90
610 | 757		69 | 99		235 | 272		848,777 | 760,201		23.44	187,216	48 | 55	754				91
560 | 399	17	6 | 3		43 | 89		215,850 | 199,000	810,600 | 581,000	7.84	39,000	42 | 37	655		129,250	4.70	92
87 | 87		12 | 35		27 | 36		159,000 | 231,000		6.06	36,000	10 | 11	2,623	55,108	3,056	2.22	93
247 | 241	75	59 | 75	2	83 | 65	85	255,383 | 248,586		10.69	54,362	33 | 36	723	70,248	8,895	3.31	94
107 | 165		45 | 66				227,360 | 257,727		9.68	29,788	45 | 42	522	47,014	15,504	2.66	95
132 | 79		47 | 2		22 | 38		227,447 | 116,654		11.23		13 | 11	1,560	32,000	24,400	2.78	96
145 | 158		27 | 22		196 | 247		378,217 | 355,724		19.50	61,600	18 | 18	1,078	57,628	48,370	5.45	97
288 | 383		22 | 40		223 | 211		298,181 | 285,158	67,700 | 65,000	15.93	52,360			78,173	11,916	4.80	98
164 | 230		34 | 70		65 | 41		127,863 | 104,372		7.37		30 | 25	577	11,738	8,384	1.16	99
41 | 50			20			110,000 | 92,000		11.62	19,953	11 | 7	859	33,087	8,739	4.42	100
46 | 82		26 | 33							9,698	21 | 19	442				101
36 | 43			12			103,000 | 89,000		12.20		2 | 2	4,217	29,600	6,400	4.27	102
73 | 73	70	8 | 4	8	101 | 98	60	64,959 | 61,864	60,000 | 55,000	10.62		7 | 7	875	14,000	6,000	3.26	103
						41,770 | 33,519		11.60	13,000	3 | 3	1,200	5,517	2,113	2.12	104
6,853 | 7,298	Y 53	1,117 | 1,306	Y 5	5,728 | 6,483	Y 67	9,800,817 | 9,303,596	19,289,072 | 17,151,504	Y 8.39	1,603,372	1,153 | 1,067	Z 1,227	2,047,663	921,865	Z 2.83	Total
IV—WESTERN—Rocky Mountains to Pacific Coast															
		58			9		56	468,061 | 488,333	28,800,065 | 27,485,561	8.10	178,527	210 | 205	2,750	350,000	340,000	1.19	105
0 | 0		0 | 0		0 | 0			1,175,000 | 1,228,000	2,325,000 | 2,100,000	7.45	155,529	73 | 111	2,157				106
1,038 | 826	55	236 | 276	6	1,475 | 1,140	60	1,031,128 | 956,433		9.51		94 | 80	1,154		87,780	0.81	107
205 | 283	55	77 | 110	15	119 | 171	60	561,000 | 674,000	2,000,000 | 2,200,000	5.47	115,000	75 | 70	1,370	220,000	122,000	3.33	108
337 | 482	75	115 | 159	5	312 | 450	75	806,227 | 938,751	5,522,737 | 5,392,039	8.09	122,736	93 | 115	1,071	379,841	135,173	5.17	109
99 | 167	57	48 | 73	6	88 | 117	78	300,624 | 225,860	4,119,376 | 3,993,300	3.51	S243,379	43 | 39	1,994	83,238	120,064	2.37	110
228 | 324		82 | 110		171 | 276		306,989 | 310,705	2,868,845 | 3,178,292	4.32	82,758	30 | 28	2,365	115,396	57,196	2.43	111
215 | 239				381 | 517		563,005 | 616,687		8.64	65,625	63 | 68	1,036	121,184	37,966	2.44	112
213 | 385	72	79 | 133	10	28 | 294	51	433,415 | 455,023	3,377,033 | 3,290,042	7.37	72,301	60 | 50	980	166,052	124,977	4.94	113
422 | 526	85	140 | 213	10	150 | 155	70	644,208 | 661,219	2,425,868 | 2,292,866	13.82	98,953	55 | 53	830				114
925 | 1,040	78	322 | 370	5	130 | 168	35	533,452 | 504,368	2,699,543 | 2,229,249	13.00	95,397	38 | 38	1,080				115
261 | 321		56 | 59		47 | 39		570,311 | 478,521		22.36	120,000	64 | 45	399				116
110 | 131		27 | 40		135 | 251		191,128 | 200,183		8.58		14 | 14	1,590				117
						16,465	14,750		4.40		2 | 2	1,860	2,400	2,661	1.35	118
5,053 | 4,724	Y 67	1,182 | 1,540	Y 8	3,036 | 3,578	Y 61	7,601,013	7,752,833	54,138,467	52,161,349	Y 5.18	1,350,205	914	918	Z 1,605	1,438,111	1,027,817	Z 2.23	Total

heaters ... ater heating expense. L All advertising. M Appliance profit covers all costs. N Includes free wiring. O Includes commercial sales. P Decrease due to rate reduction.
K Includes ... Including rural. S Total domestic annual revenue increase. Y Straight-line average. Z Weighted average, eliminating companies not reporting these items.

...rison of Sales Totals, Saturations and Averages

Relating roughly the prevailing cost of using appliances, their present popularity and the scale on which they are being sold

Ironing Machines Sold per 1,000 Consumers 1937	Vacuum Cleaners Sold per 1,000 Consumers 1937	Average Saturation Refrigerators 1937 %	Average Saturation Ranges 1937 %	Average Saturation Water Heaters 1937 %	Average Saturation Washing Machines 1937 %	Average Saturation Ironing Machines 1937 %	Average Saturation Vacuum Cleaners 1937 %	Total Appliance Sales by Power Cos. (Dollars) 1937	Appliance Sales per Consumer (Dollars) 1937	Total Annual Revenue Increase from Power Co. Sales 1937	Total Sales People on Domestic Load 1937	Consumers per Sales Person 1937	Power Co. Direct Sales Expense 1937	Power Co. Adv. & Promotion Expense 1937	Sales & Adv. Exp. per Consumer 1937	Region
2	6	44	9	2	70	6	67	58,680,639	6.10	$4,682,259	5,891	1,491	$5,203,116	$2,515,900	$2.52	Northeast
1	2	55	16	7	34	3	35	11,373,369	11.44	947,800	873	1,273	731,904	315,692	2.69	Southeast
1	4	43	12	4	53	5	67	9,800,817	8.39	1,603,372	1,153	1,227	2,047,663	921,865	2.83	Central
1	2	41	22	11	67	8	61	7,601,013	5.18	1,350,205	914	1,605	1,438,111	1,027,817	2.23	Western
1	5	46	13	48	62	6	65	87,455,838	6.98	8,583,636	8,831	1,450	9,420,794	4,781,274	2.53	Nat'l Total or Average

Utility management recognizes, however, that mere dollar volume of appliance sales is not always a criterion of load-building effort. As a step toward more accurate analysis, co-operating companies were asked this year to report estimated annual revenue (EAR) from dealer sales as well as estimated annual revenue (EAR) from their company sales. Only one-third of the reporting companies were able to report all four EAR figures. However, analysis of these companies *only* showed that for every dollar of EAR from company sales in 1937 there was an EAR from dealers' sales of $2.48. In 1936 the ratio was $1 to $2.24.

Who sells the load?

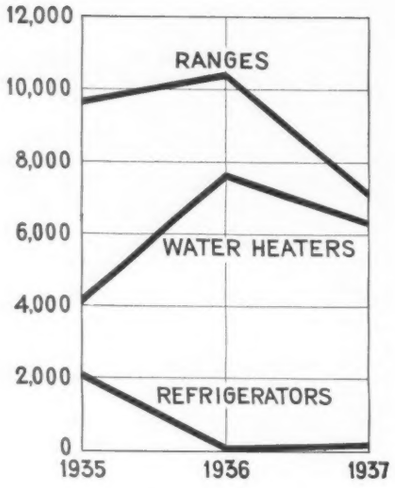
Here is the quantitative answer, for the first time on a national scale, to the question as to whether dealers really do sell EAR—a question more important to utility management than dollar volume of appliance sales. It is factual evidence of the way in which utilities have been able to guide outside selling channels along more effective lines. The total cost to the utilities is shown later.

Due to the fact that this breakdown is being published for the first time and may be of interest for regional application, the regional totals are reproduced below with the admonition that they should not be used with general figures cited in this article, as the breakdown was derived this year from only one-third of the reporting companies.

EAR from Appliance Sales
(000 omitted)

	By Utilities		By Dealers	
Region	1937	1936	1937	1936
Northeast	$1,953	$1,752	$4,121	$3,516
Southeast	580	550	2,147	1,646
Central	1,044	1,078	2,443	2,263
Western	987	1,229	2,650	2,920
Totals	$4,564	$4,609	$11,361	$10,345

Finally, the distribution nationally of appliance sales between the utility and the dealer is shown for *units* (not dollars) in the table on next page. This year, two sets of ratios are provided. The upper set applies to all companies reporting in this survey and includes those companies which do no direct selling; the lower set of ratios omits those companies which do no direct selling and comprises the results of only those companies which are listed in Table I.



Trend of rentals

The results in these tables show co-operative utility-dealer selling at its best and this situation can be expected to continue as long as the dealer mortality rates are not increased by the current depression.

Rentals decline

A year ago sales managements of a number of utility companies were experimenting with major appliance rental plans, in many cases as a psychological substitute for a long-term purchase plan. Rental curves for the major appliances shown in both tabular and chart form evidence the decline in new rentals in 1937 due perhaps to the fact that (1) better business conditions decreased the need for bolstering selling campaigns with rental plans and (2) partial cessation of rate-slashing orders reduced the need for *fast* load building.

Judging from results reported by the companies, the rental plans were soundly conceived and executed, for conversions into sales in 1937 were numerous. Range rentals were being converted into sales somewhat faster than new rentals were undertaken and water heater conversions into sales were running at about 50 per cent of the number of 1937 rentals.

Cost to build load

In an effort to appraise the cost of building domestic load in 1937, weighted averages have been applied to companies which reported complete cost data and it is found that companies' appliance sales (not including dealers) per consumer in 1937 amounted to $6.98. Highest sales, $11.44 per consumer, were reported by the Southeastern group, lowest sales ($5.18) by the Western.

The Southeastern group reported one of the lower ratios—1,273—for customers per salesperson, and the group with the lowest sales per customer reported, as is consistent, the highest number of customers per salesperson, which was 1,605.

By selecting those companies out of the above groups which reported the few cost figures listed on the questionnaire, it is found that their direct and indirect expenses amounted to $2.53 per customer. Lowest expenses per customer were found to be in the Western group ($2.23) and the active Southeastern group reported $2.69 per customer.

The over-all result is that the companies reported sales and promotion expenses of $2.53 per customer for their own direct merchandise sales of $6.98 per customer.

While this is one guide to sales results, it will be noted that (1) this sales expense is not for $6.98 of EAR, but for $6.98 of merchandise, and (2) we have yet to consider the dealer figure for sales per consumer and the EAR from the combined efforts.

Going a step further, then, it is found that the same companies which reported sales and promotional costs and in addition reported EAR from their own appliance sales and EAR from appliance sales of their dealers expended 69.8 cents in 1937 to get one dollar of EAR.

The companies which sell no appliances

For the 1937 summary seventeen utility companies located in fourteen states sprinkled from coast to coast and serving 1,348,909 residential customers presented the data tabulated in Table III.

These companies are always of intense interest to executives and to sales managements because they have transferred the responsibility of direct selling entirely to their dealers and, according to the figures presented, have done so successfully with respect to sales volume.

An appraisal of their achievements will be attempted here, along the same general lines followed for the first group of companies; *i.e.*, those which do part of the direct selling themselves. The cross-section presents a good sample, for seven companies are straight electric and ten are combination gas and electric. The ten gas and electric companies serve 490,218 electric customers and 308,330 gas customers—both figures for residential only. An inspection of electric customer totals shows that the combination companies, therefore, influence the results to the extent of about 36 per cent of the total.

First point of major interest, perhaps, is the fact that in 1937 the dealers in the territories served by sixteen of these companies increased their dollar volume of merchandise sales 13.2 per cent over their 1936 total of $30,793,479.

An indication of the extent to which these dealers sold major appliances is seen in the fact that, on a sixteen-company basis, the number of refrigerators (units) sold increased only 1.9 per cent, but the number of ranges increased 18.4 per cent and of water heaters 6.1 per cent over 1936 sales.

Right here should be interjected the thought that these figures are not exactly comparable from a load-building standpoint with other figures presented on preceding pages. As load building today is essentially a problem of management, management views differently and will draw one set of conclusions from figures based upon a group of companies where, as is the case here, a third of the customers are served by combination companies and will draw a different set of conclusions from figures based upon another group of companies where, as is the case in the preceding group, nearly half the customers are served by combination companies.

Common to all utility companies is the pressing need for holding onto net earnings, keeping people employed and serving as many customers as possible with as much service as they can profitably utilize sold at the lowest feasible rates. Therefore, the pace at which load building proceeds, and the direction it takes, has to be based to an important degree upon the over-all needs of the individual company, the potential market presented by its own customers, the loads which are most likely to be compensatory and the costs entailed to get and *hold* these loads.

Accordingly the rates of growth for dollar volume of merchandise sales given above tell the extent to which dealers' efforts were effectively increased in appliance sales in 1937 in the territory of these sixteen reporting companies and show the greatest major appliance *increase* was in electric ranges.

Total sales of merchandise, small appliances, lighting and major appliances, as stated above, increased 13.2 per cent to $34,859,277. Reduced to a per customer basis, sales of $40.06 were up 9.4 per cent over 1936.

Table III

Who Sells the Appliances

Proportion of appliances (units) sold by utility companies and local dealers as reported by the companies. This table is computed for all reporting companies, merchandising and non-merchandising.

Appliance	Company Sales, Per Cent	Dealer Sales, Per Cent
Refrigerator	13	87
Range	52	48
Water heater	69	31
Washer	7	93
Ironer	13	87
Vacuum cleaner	9	91

This table is computed for only those reporting companies which divide the merchandising job with the dealer. The effect of the non-merchandising company is not included here, and therefore this table is comparable to that published here a year ago.

Appliance	Company Sales, Per Cent	Dealer Sales, Per Cent
Refrigerator	16	84
Range	57	43
Water heater	73	27
Washer	9	91
Ironer	16	84
Vacuum cleaner	11	89

Table IV—Load Building Where the Power Company Sells No Appliances

Consumption, growth of load, average rates, revenue and number of salespeople and advertising and promotion expense per consumer, together with power company estimates of dealer sales and saturations of the major appliances

Company	Total Domestic Consumers		Av. Annual Domestic Consumption		Av. Annual Dom. Revenue	Av. Price Dom. Service —Cents	Refrigerators Units Sold by Dealers	Saturation of Refrigerators	Ranges Sold By Dealers	Saturation of Ranges PerCent	Water Heaters Sold By Dealers	Saturation Water Heaters PerCent	Number Power Company Sales Men and Women Building Dom. Load		Advertising and Promotion Expense (Dollars)		Adv. and Prom. Exp. per Consumer ($)
	1937	1936	1937	1936	1937	1937	1937	1937	1937	1937	1937	1937	1937	1937	1937	1936	1937
1	430,169	411,985	906	807	34.25	3.8	42,396	55	7,305	9	2,663	4	243	214	700,000	760,000	1.62
2	159,553	152,741	1,104	1,058	32.69	3.0	18,614	.....	4,195	.....	179	.....	26	21	.....	.....	.....
3	[A] 103,116	98,165	592	567	36.97	6.2	13,845	40	1,248	6	108	1	80	70	26,565	21,965	0.26
4	101,368	102,551	725	705	36.45	5.0	16,467	60	130	2	30	.....	15	15	80,000	80,000	0.79
5	[A] 87,151	83,618	737	672	34.71	4.7	9,198	42	1,480	5	206	1	27	26	30,000	28,500	0.35
6	[A] 82,276	78,877	.....	.....	.....	.....	10,286	55	40	.....	7	.....	0	0	.....	.....	.....
7	62,733	60,770	1,192	1,090	42.04	3.5	6,834	59	[C] 1,808	17	[D]	4	36	42	115,000	115,000	1.83
8	[A] 61,741	59,460	869	814	42.00	4.8	5,017	.....	864	.....	275	.....	22	28	40,023	25,747	0.65
9	[A] 56,221	54,480	638	581	26.05	4.1	7,133	40	72	0	19	0	22	22	.....	.....	.....
10	53,905	51,495	769	735	39.83	5.2	6,856	53	292	2	27	0	32	23	70,350	59,300	1.30
11	38,043	38,704	1,308	1,240	39.08	2.8	3,228	45	1,590	32	353	5	22	17	120,565	139,329	3.16
12	[A] 35,854	34,616	683	618	31.18	4.0	4,371	43	.....	9	.....	0	14	12	56,636	47,275	1.58
13	[A] 22,449	21,330	918	830	47.00	5.3	3,345	.....	306	.....	128	.....	26	30	76,809	64,450	3.42
14	[A] 18,796	18,316	719	672	33.10	4.6	2,436	45	0	0	0	0	4	4	0	0	0
15	12,920	12,209	650	595	35.51	5.4	1,500	50	5	1	0	0	2	2	31,000	31,000	2.40
16	[A] 12,024	11,113	876	812	48.10	5.5	1,118	70	145	20	54	10	4	4	11,133	10,246	0.93
17	[A] 10,590	9,433	1,354	1,181	49.92	3.7	1,250	60	904	50	281	13	1	2	28,347	34,000	2.68
Total	1,348,909	1,299,863	[Y] 876	[Y] 812	[Y] 38.00	[Y] 4.5	153,894	[Y] 51	20,384	[Y] 13	4,330	[Y] 4	576	532	1,386,428	1,416,812	[Y] 1.61

[A] Operate some gas service also. [C] Net increase in territory, deducting trials removed, etc., was 1,295. [D] All sales through company, with commissions to dealers. [Y] Straight-line average.

For these same companies average usage went up 8.4 per cent and the average annual residential bill went up 2.5 per cent—not far from the amounts the national averages increased during 1937.

As an index to the efficacy of sales volume in this group of companies, it may be noted that in gaining an 8.4 per cent increase in usage and a 2.5 per cent gain in the annual residential bill, advertising and promotion expenses, as reported by 13 companies, *dropped* 2.2 per cent.

It is advisable here to analyze this situation a little more. An inspection of questionnaires showed that (included in data which space does not permit our publishing here) nine companies (Nos. 1, 4, 5, 7, 8, 10, 11, 13 and 17) reported data in complete form as follows: Dealers' sales in 1937, $34,858,000, up $4,064,000 or 13 per cent; advertising and promotion expenses, $1,261,000, down $44,000 or 3.4 per cent from 1936 totals, which apparently verifies the trend figures given in the preceding paragraph.

Are dealers selling EAR?

The next question which arises relates to the extent to which these high merchandise sales are translated into EAR to the companies.

One of the companies just discussed did not report EAR on its questionnaire and another (No. 4) drastically reduced its reported EAR figure for 1937 to reflect a rate reduction, but the remaining companies showed a drop in EAR from dealers' sales of 6.9 per cent. So, to the extent that the figures are broad enough to permit an observation, it appears that the dealers of these companies sold increased appliance sales volume, but they did *not* sell increased EAR.

Yet these companies (Nos. 1, 5, 10, 11, 13 and 17) reported that their average bill increased $1.90 during 1937, from $38.89 to $40.79, as found in the tabulation. The average usage they reported as 998 kw.-hr., an increase of 88 kw.-hr. over their 1936 average consumption figure. Their range sales for example in 1937 totaled 11,877, up 1,692 over the sales in 1936. Their number of customers increased some 4 per cent, to 642,000 as of December 31, 1937.

Table V
Trends in Renting Appliances

Rentals of major appliances reported for full year of 1937 and of 1936. Companies not included in this table reported no rentals.

Company	Refrigerators		Ranges		Water Heaters	
	1937	1936	1937	1936	1937	1936
4	..	..	3,069	4,191	4,732	4,222
12	..	..	764	620	....	....
13	..	..	529	541	121	111
14	..	..	....	....	55	449
17	..	..	....	....	2	....
19	..	..	....	....	92	79
23	..	..	....	....	473	425
27	..	..	....	21	....	....
45	..	..	56	597	21	78
61	..	..	....	40	....	75
62	..	..	....	175	37	998
70	..	..	92	101	38	23
75	23	39	46	97	44	52
77	..	..	....	....	....	3
90	1	..	31	223	105	255
93	..	..	201	531	80	215
96	..	..	15	255	26	296
98	72	4	156	164	....	....
Totals	96	43	4,959	7,556	5,826	7,281

Rentals by Companies That Sell No Appliances

Company	Refrigerators		Ranges		Water Heaters	
	1937	1936	1937	1936	1937	1936
5	..	..	1,219	737	162	82
7	..	..	667	1,786	409	317
12	..	..	368	297	....	....
14	..	..	2	2	....	....
Totals	..	..	2,256	2,822	571	399
Grand total	96	43	7,215	10,378	6,397	7,680

The merchandise sales volume of these companies was reported to be $26,358,000, compared to $23,544,000 in 1936. These companies estimated that the EAR from these sales volumes amounted in 1937 to $3,199,000 and in 1936 to $3,438,000. A calculation here shows that it took $6.85 of dealer sales in 1936 to give these companies an EAR of $1. In 1937 the dealers' sales amounted to $8.24 for one dollar of EAR.

Many of these figures are not published at this time in the tables. They show that the merchandise sales volume went from $38.10 per customer in 1936 to $41 in 1937. EAR per customer from these sales is reported to have dropped from $5.56 to $4.98 in 1937, and likewise advertising and promotion expenses dropped from $1.76 per customer in 1936 to $1.59 per customer in 1937.

Costs to build load

In an effort to derive some helpful information upon the costs which were incurred by these companies to build domestic load in 1937, we start with sales per customer calculated at $40.06. It might be remarked in passing that stellar performer in raising this average was the Sierra Pacific Power Company of Reno, Nev., designated in the tabulation as company 17, reporting sales per customer of $100.

Total sales by dealers of Sierra Pacific Power were reported as $1,000,000, of which $110,500 can be calculated from the figures for the six appliances shown in table. Company 1 reported dealer sales of $16,000,000, which is $40 per customer. Company 4 reported dealer sales of $5,000,000 or $50 per customer. Company 5 showed sales of $3,497,173 or $40 per customer, Company 7 ratio was $36 per customer, Company 10 was $39 per customer based on sales of $2,096,860. Company 13 had sales of $1,519,196 or $69 per customer, and company 17 has already been identified and mentioned. For the first time in these surveys, the co-operating companies were asked to supply information on EAR from dealer sales and this year nine were able to do so. Next year it is anticipated that more companies will be able to report EAR from dealer sales as thereby all the companies will find a brand new and an up-to-date standard not heretofore available on a national scale.

This year we find the nine companies reported EAR from dealer sales of domestic appliances as $3,735,000. The advertising and promotion expenses of these same nine companies were $1 247,000, and therefore a dollar of EAR cost these companies 33 cents.

These figures naturally are limited in their application to the reporting companies in the United States. It may not be amiss to point out that they are figures, and figures only, showing what happened in the last two years in reporting utilities' territories only. These figures cannot, and do not, reflect the present market picture, nor the years of effort and millions of dollars expended to get these dealer merchandising plans where they are today. They do indicate, however, that regardless of reasons for having the dealers and their organizations do the selling job, these companies have been able to present a picture of impelling interest, despite the fact that the dealers did not sell EAR.

Protecting Transmission at Tall Tower River Crossings

Properly disposed ground wires in conjunction with line arresters or expulsion tubes on high towers compensate for adverseness of footing resistances

By L. V. BEWLEY

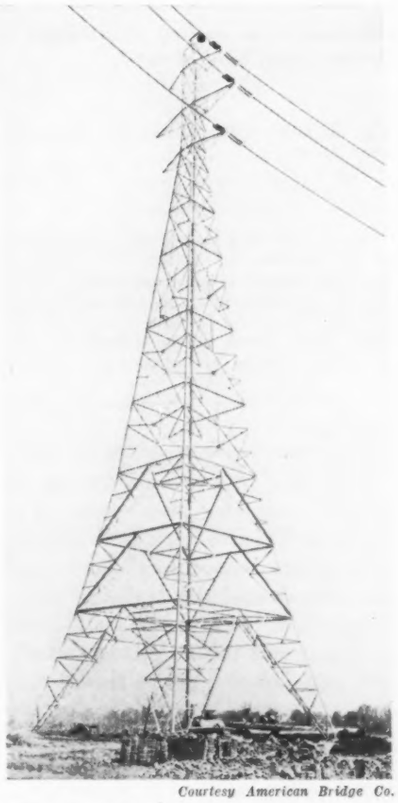
Power Transformer Engineering Department, General Electric Company, Pittsfield, Mass.

PROTECTION of a transmission line against lightning presents unique features at a river crossing where the very high towers do not permit the full advantage of low footing resistance to be realized in obtaining protection with overhead ground wires.

It is now well known that for normal tower heights of the order of 60 to 125 ft. literally, "a reduction of one or two ohms tower footing resistance is as good as an extra insulator unit," but when towers reach the great heights of 200 to 350 ft., or even more, as they do at wide river crossings, the footing resistance is not immediately available for the suppression of the lightning surge, and voltages sufficient to cause insulator flashover may very well build up before reflections can travel up the tower from ground and hold the surge voltage within bounds. It therefore becomes necessary to consider other means than low footing resistance for controlling the surge and preventing insulator flashover at river crossings.

Ground wires have triple function

There are two general methods by which this may be accomplished, both making use of standard protective devices. The first method consists in using enough overhead ground wires, suitably disposed, so as to obtain such high coupling that the voltage across the insulators during the crucial time interval cannot cause a flashover. The other method consists in making use of expulsion protector tubes, or line-type lightning arresters. These methods will be considered in detail.



Courtesy American Bridge Co.

Fig. 1—Ohio River crossing tower, 240 ft. high, of the Appalachian Electric Power Co., 132-Kv. circuit, at Kenova, West Virginia

An overhead ground wire performs its protective function in three ways: (1) By acting as a shield to the line conductors and preventing the lightning stroke from making direct contact with them; (2) by inducing surges of the same sign on the line conductors—coupling—and thereby reducing the voltage across the insulators, and (3) by presenting to the lightning stroke a surge impedance in both directions from the point of stroke, which acts in the same way as a resistance to ground.

The first function, shielding, can be adequately accomplished with a pair of overhead ground wires at the top of the tower, regardless of tower height, in accordance with recognized practice.[1] With two such ground wires the coupling is approximately 25 per cent for towers of normal height (ratio of voltage induced on the line conductors to that of the surge on the ground wires), while for a tower 300 ft. high this figure is of the order of 40 per cent. The surge impedance of two ground wires in parallel at normal tower height is about 300 ohms, while for the 300-ft. tower it is, allowing for some corona, about 370 ohms (in each direction away from the stricken point). The surge impedance of a 300-ft. tower itself may be taken as 125 ohms, and on such a tower it will be at least 0.6 of a microsecond before the first reflection can reach the stricken point from the tower base. During this period a lightning surge having a high rate of voltage rise over a 0.6-microsecond interval would very

[1] "Protection of Transmission Lines Against Lightning: Theory and Calculations," by L. V. Bewley, *General Electric Review*, April and May, 1937.

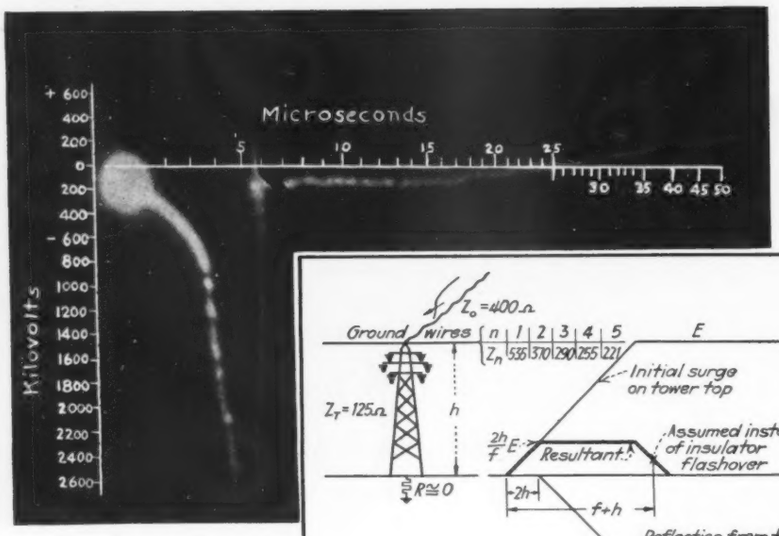


Fig. 3—Natural lightning shows comparatively slow initial rate of rise followed by a much faster rate

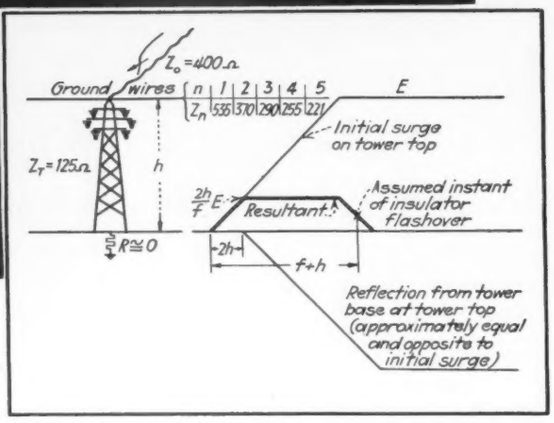


Fig. 2—Surge voltage of tower top is modified by reflection from base of tower

likely flash over the longest practical insulator string if no more than the two shielding ground wires are employed.

The "equivalent resistance" under this condition is[1]

$$R' = \frac{1}{\frac{1}{Z_0} + \frac{2}{Z_2} + \frac{1}{R}} = 65 \text{ ohms}$$

in which

Z_0 = 400 ohms = surge impedance of the lightning stroke.
Z_2 = 370 ohms = surge impedance of two ground wires in parallel.
R = 125 ohms = surge impedance of the tower.

and the voltage appearing across the insulators becomes[1]

$$V = \alpha\ (1—C_2)\ R'\ I$$

where

C_2 = coupling factor for two ground wires.
I = lightning current for a zero resistance ground.
α = crest factor.

The crest factor α takes into account the reflections between the top and base of the tower. Assuming the tower footing resistance to be very small, as is necessarily the case for good protection, the initial wave e_0 down the tower will completely reflect as $-e_0$ from the tower base. At the top of the tower this first reflection meets the surge impedances of the ground wires and lightning channel in parallel, and the voltage at the tower top due to the reflection there is

$$\frac{-2\,Z_0\,Z_2\,e_0}{Z_0\,Z_2 + (2Z_0 + Z_2)\,Z_T} = \frac{-800 \times 370\,e_0}{400 \times 370 + (800 + 370)\,125} = -1.005\,e_0$$

Thus the first reflection completely nullifies the initial wave, on the basis of the assumed impedances. This is shown in Fig. 2, from which it is seen that the crest factor is

$$\frac{2h}{f} = 2\,\frac{\text{(height of tower)}}{\text{(front of wave)}}$$

But if the impedances, particularly that of the stroke channel, are different than we have assumed, the nullifications will not be complete and the voltage may go higher. Therefore, in order to allow for some safety factor in the calculations, an α factor of twice this amount or

$$\alpha = \frac{4h}{f}$$

will be taken in the calculations.

Lightning stroke currents up to 200,000 amp. have been measured in the field. There is very little definite information concerning the shape and duration of the fronts of lightning surges, but both the oscillogram of Fig. 3 and theory[2] strongly indicate that *initially* the rate of rise is comparatively slow—perhaps for one or two microseconds—and then rises at an exceedingly fast rate, as illustrated in Fig. 4.

Assuming a lightning wave front of 4 microseconds during the fast rate, a rate of rise of 50,000 amp./microsecond would be required to reach the 200,000-amp. crest. It appears that a rise at this rate must be assumed in order to agree with flashovers known to have occurred on high towers.

Thus putting h = 0.3, f = 4.0, C_2 = 0.40 and I = 200,000 amp. (which is the maximum expected lightning stroke current) there results

$$V = \frac{4 \times 0.3}{4}\ (1—0.40)\ 65 \times 200{,}000 = 2{,}340{,}000 \text{ volts.}$$

This corresponds to the flashover of an eighteen-unit insulator string after a time of $(f + h)$ = 2.3 microseconds (see Fig. 2.). Thus the conventional two-ground wire system is not adequate for less than eighteen-unit insulators.

Ground wires above and below

If, now, additional parallel ground wires are judiciously placed with the intention of obtaining maximum coupling, it is found quite feasible to protect moderate insulator strings from flashover, even for the most severe lightning stroke. The recommended arrangements for ground wires to secure maximum coupling are shown in Fig. 5.

It will be noticed that two ground wires are always placed at the top of the tower so as to intercept the stroke, but that additional ground wires to improve coupling are located between or below the phase conductors, thereby providing maximum coupling. While coupling is the principal help in this respect, the reduction in surge impedance is not insignificant. The coupling and surge impedances should be calculated according to accurate methods for any actual case, but representative values for 300-ft. towers and various numbers of ground wires are:

No of Ground Wires	1	2	3	4	5
Coupling factor —C_n	0.27	0.39	0.56	0.63	0.70
Surge impedance —Z_n	535	370	290	255	221
Equivalent resistance—R'	70	65	57	54	51
$V = 0.3\ (1–C_n)\ R'\ I$	3060	2380	1500	1200	920
Min. No. of insulators		18	13	10	8

Of course it may not be required to secure complete immunity (to which the 200,000 amp. corresponds), in which case the calculations may be based on a lower stroke current.

For example, only 10 per cent of the total strokes to the line will exceed 75,000 amp. However, on account of the great exposure to lightning flashes offered by these high river crossing towers, it is not believed to be good practice to skimp on their protection. Moreover, while an *average* rate of rise of lightning current of 50,000 amp. per microsecond may be quite unusual, such a *maximum* rate of rise at some point on the front enduring for the time required for the reflection to return (0.6 microsecond) does not appear to be an unreasonable assumption.

The "extra ground wires" must not only span the river, but be carried to the towers of normal height on either side, as shown in Fig. 5. Possibly, also, a tower of normal height

[2] "The Lightning Stroke: Mechanism of Discharge," by K. B. McEachron and W. A. McMorris, *General Electric Review*, October, 1936.

situated on a high bluff overlooking a river crossing may in effect be no better off than a high tower, for the reason that low footing resistance may require a great depth of surge current penetration on such a bluff. A tower footing resistance measurement may be misleading in this case owing to the fact that no cognizance is taken of the remoteness of "true" ground, and therefore the time element is not accounted for. In this respect a canyon crossing is analogous to a river crossing and should be treated in the manner detailed for river crossings.

Expulsion protector tubes

In those cases were the system fault currents are such that expulsion protector tubes can be used, they may be applied to part or all of the conductors. If installed on all of the conductors they should prove as effective as ground wires, and possibly permit the use of considerably lighter towers, since the tall towers would be relieved of the extra loading due to a number of parallel ground wires and long spans.

It may be sufficient to install the tubes on only a part of the conductors, with the expectation that those which operate will cause their conductors to act as quasi-ground wires with respect to the unprotected conductors and thereby prevent flashover of insulators. In this case the top conductors must be protected by tubes, for they are the most likely to be hit by the lightning stroke. The next conductors to be protected by tubes should be the bottom ones, Fig. 6, for that gives maximum coupling with the remaining unprotected conductors.

However, this "partial protection" at such an important point as a river crossing is not recommended, and it is poor economy to save a few dollars on expulsion tubes and run the chance of an erratic stroke missing the top conductors and hitting one of the unprotected ones below. In fact, there seems to be evidence which suggests that the higher the object the greater the chance for the stroke to miss the top and contact lower down. If this is indeed a fact, then a river crossing fully protected by expulsion tubes has an advantage over protection by ground wires, unless the latter can envelop the phase wires like a Faraday cage.

In those cases where one or two ground wires exist but have proved inadequate for the river crossing, it may not be feasible to install additional ground wires. In such a case expulsion tubes can be easily added as supplementary protection and should be installed with the same priority as recommended for tubes alone; that is:

First priority—top conductors.
Second priority—bottom conductors.
Third priority—middle conductors.

Regardless of the type of protection—whether by ground wires, expulsion tubes or combinations—the controlling rules are:

First—Shield as many conductors as possible from a direct hit by overhead ground wires or tubes on the top conductors.

Second—Adopt a configuration to give the maximum possible coupling consistent with adequate shielding and existing line arrangement.

Of course these two requirements are to a certain extent opposing, but a good compromise can always be worked out.

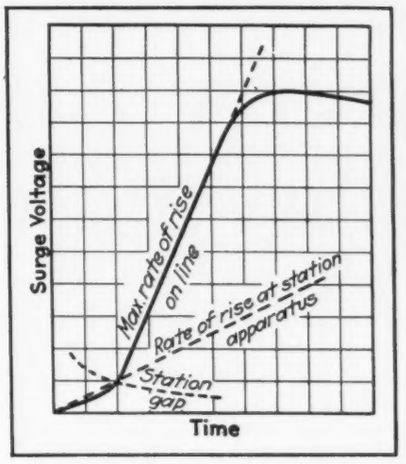


Fig. 4—Maximum rate of rise to which line insulation and station apparatus may be subjected by a lightning surge

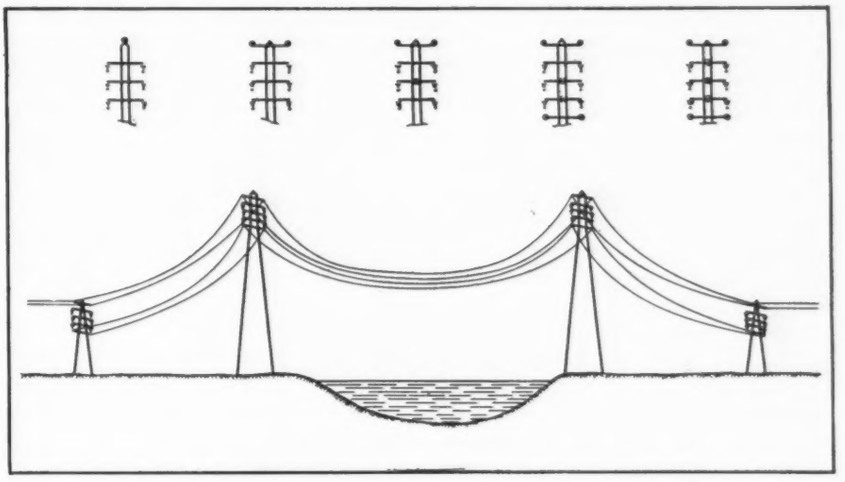


Fig. 5—Ground wires on river crossing towers
Top—Typical arrangements for one to five ground wires. Bottom—Showing the river crossing" ground wires carried to adjacent towers of normal height.

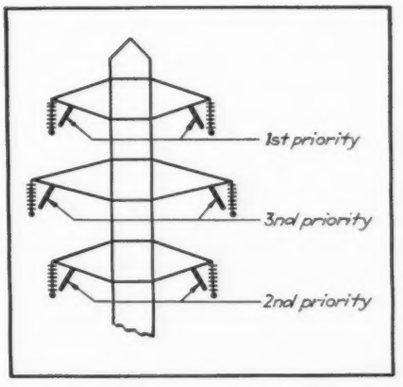


Fig. 6—Priority on the location of expulsion tubes at river crossings

Line type lightning arresters

It is not always possible to use expulsion tubes, because there is a minimum 60-cycle short-circuit current which is insufficient to blow out the arc by expulsion action, and there is a maximum short-circuit current which may burst the tube. For these reasons a suitable expulsion tube is not always available for a particular system. In this event some consideration may be given to line-type arresters, the characteristics and limitations of which are obtainable from the manufacturer. Arresters used in this fashion function to protect the line in exactly the same way as do the expulsion tubes and should be applied according to the same principles.

Industry Needs Utility Power

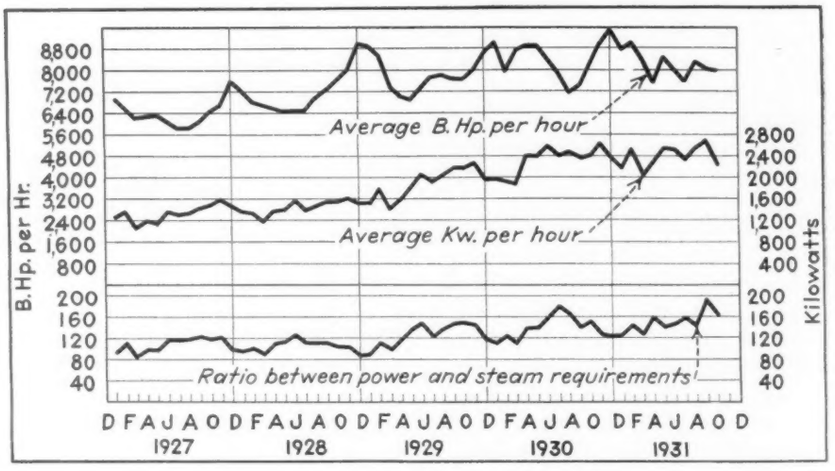
Completely self-sufficient industrial power plant a practical impossibility if all elements of economy and production requirements are taken into consideration

By W. S. MONROE

*President Sargent & Lundy, Inc., Chicago**

HOWEVER startling may be the theoretical economy of power production as a by-product of heat requirements in an industry, the difficulty of achieving —and, more important, of maintaining—an actual balance between heat and power demands makes that theoretical economy in most cases very difficult to realize. Therefore, purchased power must be a necessary part in practically every economical solution of the problem of industrial power supply.

In the early days of the electric power industry, say back in the good old days before the war, when life was easier and simpler than it is now, the industrial power problem was also very much simpler and easier than it is today. In the old times, if a factory generated its own power, it usually had a generator driven by an engine running on a steam pressure of 125 or 150 lb. per square inch and exhausting at atmospheric pressures, the exhaust steam being used for heating in winter and for such industrial apparatus as driers and hearts. There were, of course, even before the war, a few condensing turbine plants in some of the large factories, but by and large most factory power plants used low-pressure steam and were non-condensing. Frequently, if not always, a great deal of exhaust steam was absolutely wasted and the efficiency of the plant was very low. The power engineer of the electric power company then had only the problems of convincing the factory manager that it was cheaper for him to buy his electric requirements from the power company and run his boiler plant for the industrial steam requirements and for heating. In that way he could reduce the steam pressure on the boilers and prolong their life for many years.



Heat and power balance may not endure

Even if local power production does start out with good balance between heat and power demands, this happy condition cannot be counted on to continue. Note how in this five-year chart of steam (top curve) and electricity (middle curve) demands of an oil refinery the power requirement rose much more rapidly than did the steam. This condition appears clearly in the bottom curve of ratio between power and steam requirements, which rises from about unity to 150 per cent in less than three years.

Conditions changed after the war

In the years since the end of the war, however, there has been a great change. At that time the highest steam pressure, even in the large plants of the electric power companies, was only about 275 lb. per square inch. The electric power companies, with the eager vitality which they have always possessed for reducing the cost of electric energy to consumers, started in to improve the efficiency of their generating plants. This led to the "high-pressure development," which has increased steam pressures and temperatures very rapidly since that time and has accomplished wonderful improvements in the cost of plant operations. Now there are many steam plants going into operation at 1,200 to 1,500 lb. per square inch and steam temperatures up to 925 deg. F., and boilers, pipe and fittings, as well as turbines, have been practically standardized for such conditions.

During this period factory tech-

* Adapted from paper to Great Lakes Power Club.

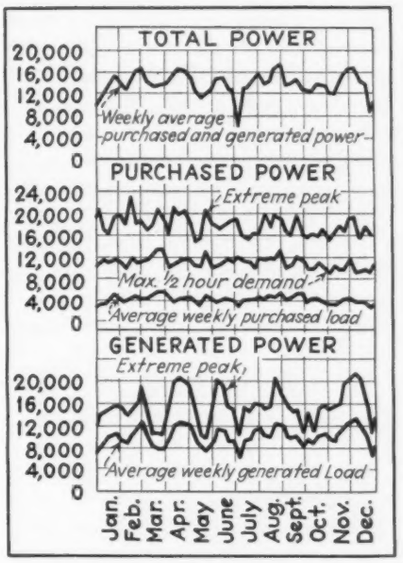
nique has also shown a remarkable development and in all fields has become more complicated. In every kind of factory production the kilowatt-hours per unit of output have greatly increased and heat requirements for factory process have become much more complicated. Often steam is required in factories at several different pressures and innumerable kinds of steam-using cookers, driers, digestors and heat exchangers are employed.

Heat requirements complicate power problem

There are innumerable kinds and classes of industrial plants. For example, there are dozens of different kinds of steel mills and a great variety of textile mills and food product establishments. No two are alike.

Furthermore, in practically all of these establishments the power problem is complicated by a heat problem of one kind or another.

Many steel mills, especially the large ones, have a by-product fuel problem. They make large quantities of blast-furnace gas and coke oven gas which must all be used in one way or another, and to the best advantage. Food product plants, rubber factories, paper mills, most textile mills and others, require large quantities of steam in their processes, which must be applied in different ways, sometimes continuously and often for short periods at a time. The use of by-product fuels, such as blast furnace gas, or the production of steam for heating and its distribution, is just as important a problem for the individual industry as its power problem, and is often more so.



Purchased power provides excess capacity at no cost

With an actual average power load of from 14,000 to 16,000 kw., as appears in the curve of total power, the steel plant here represented has an extreme peak of more than 22,000 kw, but a billing demand (max. ½ hour demand) of only about 13,000 kw. maximum. The difference between the extreme peak and the billing demand is capacity available to the steel plant for which no payment is made. But all of the capacity for the extreme peak on generated power, as shown in the bottom graph, must be paid for in provision of local plant capacity.

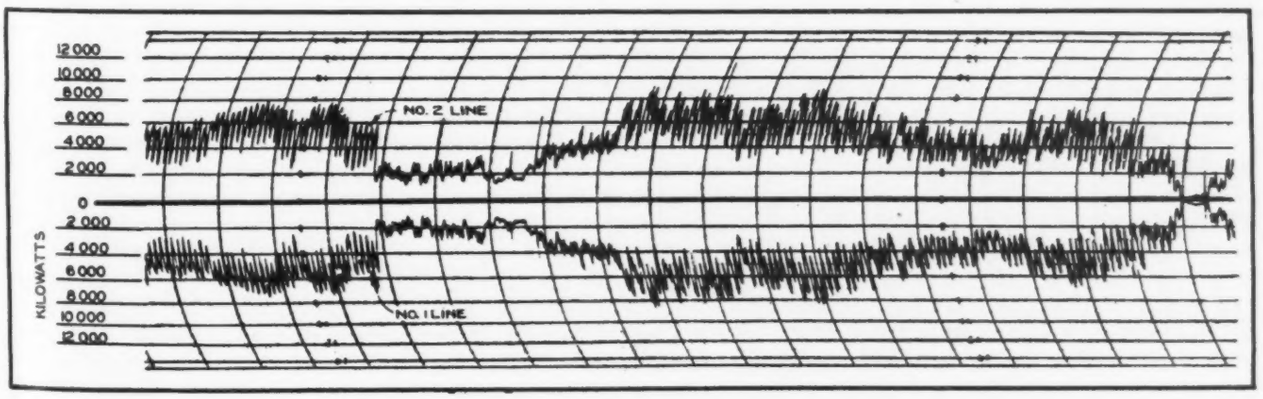
In most cases the efficient way for a large steel plant to dispose of its by-product fuel is to use it for producing part, if not all, of its electric power supply; sometimes it can profitably sell part or all of its coke-oven gas. The only way for most factories to provide for the steam heat requirements is to install a boiler plant on the factory grounds. In these days, when boilers, piping and turbines for steam pressures of 400, 600 and even 1,200 lb. per square inch have become practically standardized, the factory manager learns that in every 100,000 lb. of steam at, say, 600 lb. pressure and 750 deg. temperature there is about 3,000 kw. of energy to be obtained by putting in a turbine and exhausting at, say, 150 lb. per square inch, for steam to be used for industrial purposes. If the initial pressure is 1,250 lb. the energy available from the high-pressure steam is about 50 per cent more.

From the standpoint of the factory manager it seems the logical thing to put in such a plant. In many cases it is, and in most cases it is not.

Heat needs fluctuate more than power

When one begins to figure on that scheme one immediately runs into a number of complications from an economic point of view. The high-pressure plant is more complicated and more auxiliary apparatus is required in the way of economizers, air heaters or other heat-recovery equipment to retain the high boiler efficiency that is expected with a higher pressure. Therefore, the higher pressure boiler plant is considerably more expensive than that for low pressure. This applies especially to plants of medium size, in which the cost of auxiliary apparatus is a larger percentage of the cost than it is in the very large plants.

But I wish to point out that the thing which complicates the indus-



Load fluctuations absorbed by power system

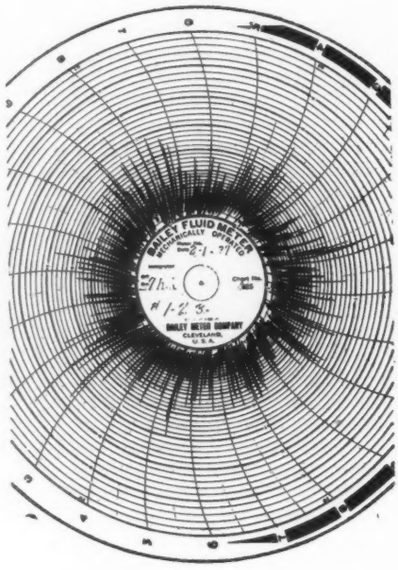
Here is the load on two utility lines supplying power to a steel mill as shown by a high-speed recording wattmeter. The period of heavy load is only a matter of minutes, but long enough, however, so that if the power were supplied by local generation, capacity to handle the heavy load period would have to be provided. But being a load on purchased power, the required capacity is only the half hour average of these peaks and valleys.

trial heat problem more than any other is the fact that in almost all cases the steam demand in the factory fluctuates much more than the power demand. It is greater in winter than it is in summer, but, more than that, it varies from day to day and from hour to hour. In many cases there are violent fluctuations from minute to minute. Such conditions make it impossible to "synchronize" the steam heat requirements with the power demand. If they are both supplied from the same plant there are many times when the steam demand is more than the exhaust from the power-generating turbine will supply, and there are other times when the power generation will furnish more exhaust steam than plants and more or less complicated and expensive auxiliary equipment in the way of pressure-reducing valves, desuperheaters and automatic control. It also makes the plants more difficult to operate.

There are some large industries—notably sugar refineries and packing plants—which, in their processes, use steam at several different pressures and also require large quantities of hot water, and consequently they have a very complicated heat cycle. Some of these have been worked out in the factory power plants with ingenious but elaborate arrangements of heaters, desuperheaters, heat exchangers, etc., and with condensers for heating hot water which serve to some degree as heat storage at such times in the day as the power turbines make more exhaust steam than the industry absorbs in its processes. I believe that in most of such cases the industrial plant would have been much less expensive in first cost and simpler to operate if the electric power system were connected to the power company as well as to their own generators.

Each case constitutes a different problem for solution

The factory power problem of today comes up in many different forms and never in a simple one. New factories, with new power plants, are not built very often. Most factories have grown up from comparatively small beginnings and the power problem comes to the front when additions to the factory are to be made or when new developments in factory technique require more power or more heat or both. There is generally an old plant with some very good equipment and much that is old and inefficient. Thus no two industrial power problems are exactly alike and each one requires careful engineering study, and when the power company is involved, as it usually is, it requires the best possible co-operation between the engineers of the power company and those of the industry. In many cases, especially in the larger factories, it develops that the most efficient solution of the problem—that is, the solution which gives to the industry the lowest cost for electric power and industrial steam—calls for a connection to the electric power company so that the industry can use the power company's service for a part of its electric power supply.



Irregular steam prevents steady power production

This steam-flow diagram is from the plant of a rubber company where greatest steam use is in vulcanizing presses. Up to the time that local generation was considered the rubber company knew only how much coal was burned and thought that a by-product power plant would be a good investment. But when the utility got permission to install steam-flow meters the picture changed, because the records showed that satisfactory power generation would be impossible with such a fluctuating steam requirement.

It is my personal opinion that the time is coming when practically every industry will be connected to the local electric power company for at least a part of its electric power requirements. There are many advantages to the factory management in having a connection to an outside power supply, no matter how much power it may be warranted in generating in its own plant. These may be stated:

1. A power supply from the outside materially reduces the amount of equipment required in the factory power plant, and consequently reduces the fixed charges. No reserve equipment is required for power generation, because at times of overhauling turbines and generators or in cases of an emergency shut-down power can be taken from the outside lines. Furthermore, much auxiliary equipment can generally be dispensed with altogether. In some cases, where a relatively large amount of steam is required, condensers on the turbines can be entirely omitted.
2. As the factory power load increases, the additional load can be built up on the power company system until it gets so large that the factory is warranted in making a new analysis of its power problem.
3. A power connection to the outside mains simplifies the plant operation. There is less equipment to maintain, voltage and speed of motors are kept steady and uniform, and when motors have to be added or enlarged it can be done without concern about having an adequate power supply. The power demand almost invariably grows faster than the heating load. When electric furnaces are to be installed the heat itself becomes a power demand.
4. The plant can be run under the most efficient load conditions and variations in load can be reduced to a minimum, because sudden increases in power demand can be taken from the outside lines.
5. The competition between the cost of power generated and that purchased has a good effect on the plant engineers, stimulating them to get the best possible results in plant operation.

Utility fixed charges lower

Another thing which is in favor of the power company is that the fixed charges that are figured into the power company's rates are in most cases much lower than the fixed charges that should be figured on an industrial power plant. In this day and age, when changes in manufacturing technique come along very rapidly, factory equipment and factory power plants have to be written off in a very few years. Power, however, is a staple requirement, like water, like pig iron in a factory storage yard. The demand for power in industry is continuous and unremitting—it is fundamental and is the essential and vital force of modern industrial production, and every change in factory technique increases the power demand per unit of factory output. The power company has an advantage in being in a position to meet these demands immediately and with little or no change in equipment.

Utility Revenue Up 2.4%

December brings small gain over year ago—
Domestic and retail sales continue to increase
—Industrial consumption declines

RISING about $2,000,000 over the preceding month's figure to $189,229,000, the revenue of the electric light and power industry in December again surpassed all previous levels for that month, according to statistics announced by the Edison Electric Institute. But the margin of increase over the preceding year, which had gone to almost 9 per cent in June, has been steadily shrinking and in December was only 2.4 per cent, thus clearly reflecting the adverse influence of slackened industrial activity on energy sales.

This influence stands out even more sharply in the kilowatt-hour figures. The amount of energy generated, which heretofore has been greater than it was a year ago, though at a decreasing rate, fell 4.1 per cent under last year's figure to 9,449,-005,000 kw.-hr.

It should be noted that these comparisons, beginning with last October, are based on a revised monthly series which gives the revenue for December, 1936, as $184,780,500 and the energy generated as 9,848,-390,000 kw.-hr. Corresponding quantities for October and November were given on page 43 of ELECTRICAL WORLD for January 29, 1938.

Less Wholesale Energy

The impact of the depression on sales for industrial power is apparent from Table II. Early in the year large light and power customers were using much more energy than in corresponding months of 1936. In March the excess was nearly 25 per cent. It then gradually diminished but was still above 16 per cent in June. By November it had vanished, with sales 4.3 per cent under 1936. The shrinkage continued. In December this group used 15.6 per cent less energy than a year ago.

Much greater stability is seen in other classes, where substantial gains have been maintained. Domestic consumers used 10.5 per cent more energy than in the preceding December, small commercial consumers 12.1 per cent, compared with 18.2 and 13.7 per cent, respectively, last June.

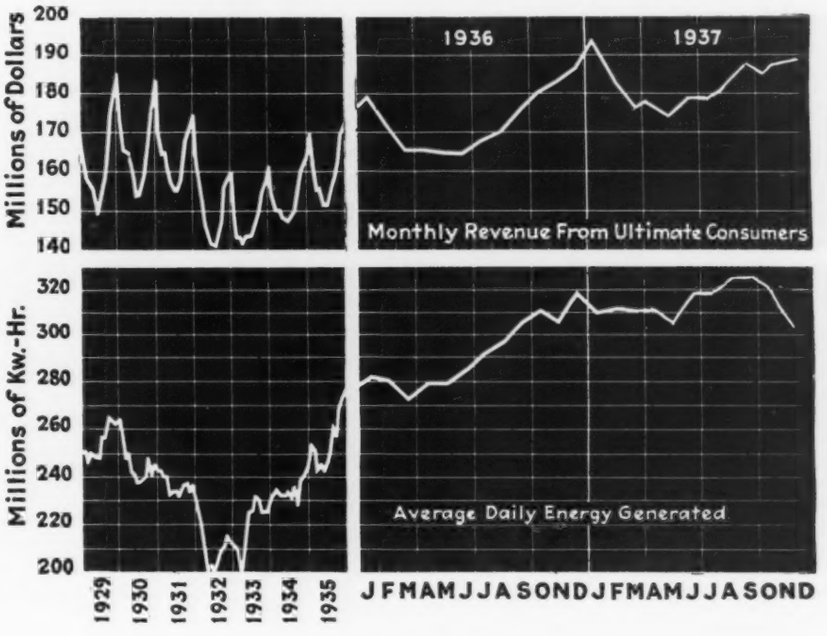


Table I—Monthly Revenue from Ultimate Consumers and Energy Output of the Electric Light and Power Industry

Compared with Corresponding Month of Previous Year

Month 1937	Revenue from Ultimate Consumers‡		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
December	189,229	+2.4	9,449	−4.1	3,308	+0.7	6,141	−6.4
November	187,296	+3.5	9,315	+ 1.5	3,416	+12.9	5,899	− 4.1
October	186,456	+5.1	9,910	+ 3.3	3,086	+ 0.1	6,824	+ 4.8
September	186,847	+6.4	9,754	+ 6.4	2,947	+ 7.5	6,807	+ 5.9

* By courtesy of Federal Power Commission, with deductions for certain plants not considered electric light and power enterprises. ‡ Edison Electric Institute.

Table II—Allocation of Energy by Classes of Service, 1937

Compared with Corresponding Month of Previous Year (Edison Electric Institute)

Class of Service	December		November		October	
	Millions of Kw.-Hr.	Per Cent Inc.	Millions of Kw.-Hr.	Per Cent Inc.	Millions of Kw.-Hr	Per Cent Inc.
Total for distribution*	9,707	− 2.6	9,536	+ 2.6	10,123	+ 4.8
Lost in transmission, etc.	1,667	+ 4.8	1,368	+ 6.7	1,615	− 0.1
Sold to ultimate consumers	8,040	− 4.0	8,167	+ 2.0	8,508	+ 5.7
Domestic	1,662	+10.5	1,614	+12.1	1,529	+12.5
Com'l, small light and power	1,636	+12.1	1,600	+13.5	1,552	+15.2
Com'l, large light and power	3,858	−15.6	4,201	− 4.3	4,712	+ 2.9
Municipal street lighting	243	+11.3	199	− 3.4	188	− 4.6
Railways — street, interurban	423	+ 0.5	370	− 2.3	355	− 1.5
Railroads—electrified steam	118	− 3.9	104	− 4.7	104	− 2.4
Municipal and miscellaneous	100	+22.9	79	+ 1.2	77	− 3.9

* Generated, purchased from other sources, imported, less energy used in railway and other departments.

Editorials

S. B. WILLIAMS, Editor

TVA in Another Yardstick Role

IS TVA about to set up another yardstick? It has become famous, or infamous, as one looks at it, for its yardstick program on electric rates. Arbitrary rates set up to force private utility rates everywhere to lower levels, they bore no semblance to value or fair return. And now that same policy would appear to be turned to the matter of determining what should be paid by government for private power company systems.

The policy of the two directors who are now in the saddle is changing. At first their attitude was why pay anything for competing power systems. Next they might take over such distributing systems as they could use and now they offer to take over whole systems at prudent investment value less depreciation with no allowance for going value.

This is a view which is entirely at variance with property transfer practices even when the government is the buyer. If a government agency wants a tract of land for any purpose, it pays a fair value, which in most cases is in excess of the current going or market value. Aren't the power companies entitled to as fair treatment from the government as any private citizen would expect?

A power system isn't just some generators, transformers, wire and other physical equipment. It is more than that. It is a market developed to buy so much electricity; it is a personnel trained to offer a service; it is an engineering plan laid out in certain very definite directions, and all properly co-ordinated for reasons of economy, efficiency and possibilities of growth; it is an organization that can take these physical equipments and put them to use at a profit. And it is for these values that the TVA proposes to offer nothing.

At this writing both sides are still far apart. Whether they can get close enough together to effect a settlement remains to be seen. If the utilities and the TVA directors attempt to work out any plan it is almost sure that nothing will be accomplished. For that reason an independent commission should be given the task of finding either a fair value or a basis for the sale of the private properties.

The precedent that will be set down in this instance will go far beyond the Tennessee Valley. Moreover, the result will in large measure determine the future financing program of the private utility industry. A fair and reasonable settlement will remove one of the biggest stumbling blocks to investment in new utility construction.

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Switchgear Offers Opportunities to Capitalize on Advances

OIL-TIGHT construction and the more effective modern interrupting structures of circuit breakers have steadily moved downward into the lower ratings commonly used in industrial plants as well as in utility distribution substations and power-house auxiliary applications. There are, however, many of the less modern breakers in service, and the question quite naturally is raised, Why supplant them if "they have never given any trouble"? If they were the sole arbiters of their destiny they might never give any trouble before they were replaced for basically different reasons of insufficiency.

Circuit breakers are peculiar pieces of electrical equipment, in that they depend not so much on what is beyond them as what is behind them. The circuit served by a breaker may remain wholly unchanged in loading and other characteristics, nevertheless it may become progressively inadequate. This is because the system serving it is inevitably growing in size and in quantity of power generation feeding it. The result is that any fault occurring beyond the breaker exposes the breaker to an ever-increasing risk of ever-increasing short-circuit currents which it must interrupt safely if the facilities *beyond* are to be protected from the fault-enhancing propensities *behind* it. That is none too well recognized, and as a consequence many unsuspected points of fire and explosion hazard could be uncovered. The blame is not as much on the breaker itself as on the incessant progress which adds more and more kilowatts to the country's power systems.

Of course, wherever this is recognized and changes are made in the direction of greater safety (to humans and equipment) advantage should be taken of the accompanying trends in switchgear design. Manual link operation from the operating board could well be replaced by a.c. battery or rectified a.c. operation so as to remove the breaker further from the operating position than linkage can usually justify. Full steel inclosures also afford greater flexibility, smaller space, better segregation and isolation, greater mobility. Simplification of panels results from having only the essential instruments and controls on the face of the board, all relays and accessories being mounted behind the operating panel, on a supplementary panel or at the breaker inclosure.

A modern switchgear installation simplifies the

task of the operator in emergencies, offers enhanced safety, interrupts without distress, saves valuable space and promotes ease of alterations and expansion of the electrical activities, whether it be a utility or industrial situation.

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Load Building Responsibility Still Rests With Utilities

IN THIS ISSUE there is presented the Eighth Appliance Sales Survey, a summary of the load-building results in 1937 of utility companies serving approximately fourteen and a half million of the domestic consumers in the United States. Information was submitted by companies serving a quarter of a million additional customers, but it came too late to be used in the survey.

Coming, as it does, at this time, the survey information appears just before the opening of the industry's Annual Load Building Conference at Chicago. Thus, a large fund of up-to-date information is made available for advance analysis and interpretation.

This year ELECTRICAL WORLD has endeavored to hold up a mirror reflecting the sales activities of these many companies—and their co-operating dealers, as reported by the companies. The principal goal has been to present the facts, useful to those men of the industry who must produce the gross and net to keep these utilities in business.

The activities may be analyzed in any one of a number of directions. Everybody, of course, is interested in dealer-utility co-operation on appliance sales, and in the article emphasis has been placed upon this aspect of the business. No conclusions are drawn here as to what may be best, for these averages will no more fit the individual utility than an average Yale key would fit the Yale lock on the front door of the individual utility.

This year we carry the theme right into EAR, but not because we are unaware of its limitations. The inaccuracies of EAR have been pointed out for some years now, and as soon as the companies turn to a better measure of sales effort, that new measure will be reflected in this mirror. Meanwhile, we, of course, accept the figures given to us by the companies and, assembled here, they result in a very interesting picture.

All of the figures were given on a confidential basis, but a large number of the companies are permitting us to divulge their identities to utility sales managers. Therefore, a company can use these data as a starting point for further helpful analysis of its own operations.

Subject to the limitations of the estimates submitted, of slide-rules and averages, this survey can help a utility better to analyze the pace, direction and cost of its own operations and thereby help in finding the answer to the current need for salvaging more than a 3 per cent increase in revenue out of a 9 per cent increase in kilowatt-hours. This, indeed, is the essence of the load building job and this survey shows that nobody but the utilities can be expected to follow through and see that it is done.

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Still Costs Less to Haul Coal

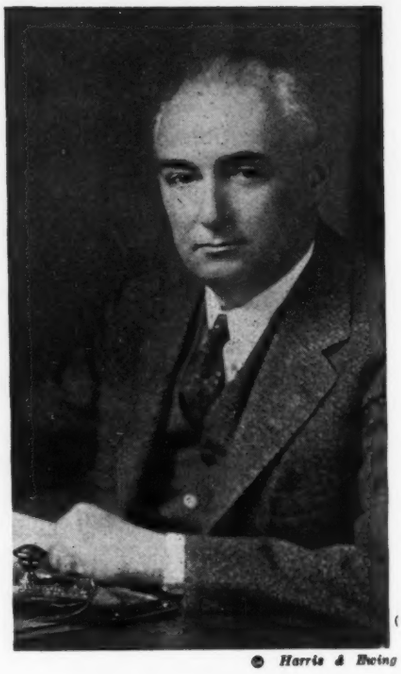
IN SPITE of the acceptance by engineers of the fact that electricity can, in general, be supplied to the user today at less cost from fuel than from falling water, there are still some few men who defy the arguments of reason and assert the opposite. Their voices, raised in denial of economic truth, were heard after Frank F. Fowle presented his now classic paper on "The Nation's Power Supply" at the Midwest Power Engineering Conference in Chicago, April 22, 1936. Their dissent was heard again when the conclusions of Mr. Fowle's paper again came into public notice in newspaper stories of the government report on "Technological Trends and National Policy," released by the National Resources Committee in June, 1937.

Taking notice that such figures as were advanced by the hydro defenders compared government water power to steam power in private plants and thus ranged subsidized development against enterprise in which all costs are counted, Mr. Fowle has written a supplementary paper in which the factor of subsidy is applied to steam power electricity supply so as to put the comparison on an equal footing. As may be seen in the abstract of this second part, which is published in this issue of ELECTRICAL WORLD, subsidy applied to both does reduce the cost differences between hydro and steam power. But it only reduces them significantly when hydro is considered on any reasonable basis of unit cost. Hydro can be made to show a better economy by battering down its unit cost to extremely low levels. This can be done by assignments of cost proportions in government power projects to navigation, flood control, irrigation, erosion control and other indirect contributions to the abundant life, wholly unrestrained by considerations of engineering, economics or traditional regard for equity.

And subsidy or no subsidy, the present analysis shows that considering transmission alone, without regard to power generation, it still costs less money to transport power as coal in railway cars than as electricity over wires except for short distances. The distant hydro development can overcome that handicap only by taking arbitrary advantage of excuses for hammering down the proportion of the whole development cost assigned to power.

TVA Formula Upset by Ross Plan

By CARTER FIELD



Harris & Ewing

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

GEORGE W. NORRIS, John E. Rankin and David E. Lilienthal have their heads bowed down in sorrow. A comrade has turned Trotsky on them. For no reason they have been able to comprehend, J. D. Ross, branded as a dyed in the wool public ownership man, an outstanding success in public operation of an electric plant in Seattle, and just made administrator of Bonneville, has messed up the whole TVA situation.

In a letter which he, as they see it, had no excuse whatever for writing, Mr. Ross advised John R. Neal of Knoxville of his views on the subject of buying out privately owned utilities. He not only urged that paying a fair price was good business for the publicly owned systems in the long run, but talked about their values as "going concerns," prated about their gross and net earnings, as though that had something to do with it. Not a word about "second-hand junk" value. Nothing even about "prudent investment"!

It was the first time they realized that Ross is just an economic royalist at heart! A Wall Street bull in New Deal clothing! And how his ears must have been burning!

F.D.R. is making the best of it. He admitted that, while he had not read the Ross-to-Neal epistle, he knew pretty well what was in it. In fact, gave the newspaper men to understand that there was no conflict in policy. And then changed the subject.

Which is even more disturbing to Lilienthal, Norris and Rankin. For now they are not absolutely *sure* of Roosevelt himself. He has been saying some strange things lately. For example, right after the Supreme Court decision upholding the right of the federal government to make loans and grants to aid municipally owned electric developments Mr. Roosevelt virtually went out of his way to tell the newspaper men that he assumed the various local governments concerned would negotiate with the privately owned utilities, with a view to buying them out, at fair prices, so as to avoid useless duplication of facilities!

At the time the Norris-Rankin-Lilienthal crowd was not much disturbed. They knew, they thought, what the President's idea of a "fair price" was. It was not as low as Rankin's "second-hand junk" value, but it was his own conception of "prudent investment" value, which has been described at length in these articles. Boiled down, it means only money honestly spent, money wisely spent, and no allowance for unearned increment.

But this comment of the President that the Ross letter is not in conflict with his own policies is something else again. For the Ross letter goes a long way from the prudent investment formula as laid down in the recapture under license provisions of existing law, and in the President's own description of it.

For instance, Mr. Ross said in his letter the President knew about:

"The principal question is the value that can be given to buy out a competitor. This considers a study of the gross income, the net income, the cost per kilowatt and kilowatt-hour for generation, transmission and distribution, the original value and the depreciation that should be applied to it, and the present physical value as shown by any available valuations."

Mr. Ross further outraged his erstwhile comrades by proving with figures in the Seattle case that the saving on duplication would enable the publicly owned plant to retire the entire debt incurred by paying a fair price for the privately owned competitor in twenty years!

And to add oil to the flame, he then set up a proposal for municipally owned systems which contemplate "a normal gross revenue tax," adding, "it is the solution of the tax question in power systems."

And if there is one thing in the world that Lilienthal, Norris and Rankin do *not* want to talk about it is this same tax question—either the taxes now paid federal and local governments by the utilities, or the factor which taxes constitute in fixing rates.

All of this has been provoked, of course, by the offer made, some two months ago, by Wendell L. Willkie, president of Commonwealth & Southern, to sell out to the government. At that time Mr. Willkie agreed to accept any price which might be approved as fair by a board of three, one member to be named by his company, one named by the President and one named by the Supreme Court.

The offer has been rankling ever since. It was beyond doubt the most embarrassing proposal ever made by any one in the electric industry. It made the picture entirely too clear, even to the least interested voters. It carried conviction that the utilities must be getting a terribly raw deal

[*Continued on page 145*]

News OF THE WEEK

TVA Makes Proposal to Purchase Private Utility Properties in Area

Willkie to confer with Lilienthal on plan to settle agency's power question — Chairman Morgan demands Congressional investigation — Refuses to resign as controversy gains national importance

Administration leaders maneuver to sidetrack TVA inquiry by Congress

Chairman Morgan refuses to resign; asks TVA setup showdown

Lilienthal makes proposal to buy private utility properties

Willkie accepts proposal for negotiations, recommending Ross purchase formula

Comptroller-General's office challenges legality of TVA outgo

Swift developments in the controversy in the Tennessee Valley Authority, which has swept the Federal subsidized power agency into the spotlight, gained national importance this week and appeared to center, for the coming November Congressional elections, the question of widespread government entrance into private business.

Last week Dr. Arthur E. Morgan blew the lid off the smoldering volcano, which has been raging in the TVA directorate for many months, by demanding a congressional investigation of the agency's activities. "The TVA deserves a fair and open hearing, which is full and impartial, with nothing hidden, and without predilection for or against any person or against the TVA itself," Mr. Morgan said.

In the first move to combat Chairman Morgan's charges of "conspiracy," "waste," "lack of planning," "evasion" and "intrigue" against his two co-directors, David E. Lilienthal and Harcourt A. Morgan, the TVA proposed the purchase of private utility facilities in the TVA area on a basis of "actual legitimate cost, less depreciation accrued since the properties were installed."

Wendell L. Willkie, president of Commonwealth & Southern, accepted the proposal made by Mr. Lilienthal and suggested that the facilities be purchased as systems. "I am, of course, delighted to accept your proposal to resume negotiations immediately for the purchase, on a comprehensive basis, of certain properties in the Tennessee Valley," Mr. Willkie wrote Mr. Lilienthal. "The importance of acquiring and paying for utility properties as going concerns has been publicly affirmed by J. D. Ross, the country's most successful operator of publicly owned power systems."

President releases letter

When the TVA situation broke out into the open President Roosevelt made public a letter he had received from directors Lilienthal and H. A. Morgan in which they suggested that since Chairman Morgan did not agree to their ideas, the majority rule, that he resign. The two TVA directors charged that "disagreement and differences of opinion are not objectionable of themselves" but after a majority decision is reached the decision should be accepted in "good spirit, without rancor and without personal feeling."

The two TVA directors charged that it is not permissible for Dr. Morgan "to attack the personal motives and good faith and impugn the integrity of his associates on the board, not upon the basis of direct charges, but by innuendo, indirection and aspersion." They suggested that Dr. Morgan resign.

Senator George W. Norris, who has been the Senate sponsor of TVA, pushed forward his proposal that the Federal Trade Commission investigate TVA instead of a joint congressional committee. Administration leaders were closeted in conference during the past week in an attempt to sidetrack a congressional inquiry into the affairs of the Federal power agency.

Offers five-point plan

This week Mr. Lilienthal outlined for public utility companies a five-point basis on which he would negotiate for the purchase of properties in the TVA area. In a letter to Mr. Willkie it was stated by Mr. Lilienthal that the TVA and the utilities would have to take into consideration the following:

1. A study of operating records of the companies for the purpose of obtaining electric revenues, expenses and net earnings over a period of years.
2. A study of the fixed capital records relating to the cost of the electric generating, transmission and distribution properties involved.
3. A general field survey of the electric properties.
4. A study of the accrued depreciation of such electric properties.
5. A study of the financial history of the Tennessee Electric Power Company.

On the heels of the new TVA purchase proposal the Comptroller-General's office challenged the legality of TVA expenditures of $4,748,505 over three years. Accountants stated they had challenged expenditures of $2,013,326 for the fiscal year 1934. Their examinations of 1935 and 1936 fiscal year accounts increased the figure.

This development added more fuel to the controversy, which led Senate Majority Leader Alben W. Barkley, Democrat, of Kentucky, to assert that something might be worked out to avoid an inquiry. He said that he favored a FTC investigation to one by

Congress. Sentiment appeared to be gaining support for a joint inquiry by the Congress.

For many months it has been generally known that there was internal strife in the TVA board. Dr. Morgan has long advocated that the TVA power policy be worked out whereby investment in private utility systems be preserved. He has also opposed the duplication of present facilities.

In a letter to Representative Maury Maverick of Texas, Mr. Morgan stated that "as I think you know, Mr. Lilienthal and Dr. H. A. Morgan invariably vote together on all board matters." Mr. Morgan charged that while he was in Washington, during the first days of the TVA, getting the organization planned, "the two other directors were in Knoxville preparing a plan for a division of functions within the board."

As the week progressed the drive to bring about a full public airing of the TVA grew stronger, with Senator H. Styles Bridges and Senator William H. King jointly demanding a full investigation. "We want a full investigation by the same agency which created TVA—by Congress," Senator Bridges declared. "It should be a complete investigation or none at all." He was opposed to any "whitewashing" by the Federal Trade Commission, asserting that the TVA dissension had "the making of another Teapot Dome scandal."

Roosevelt calls Directors

With Senator Norris appealing to Congress that the present controversy in TVA was "jealousy" of Mr. Lilienthal by Dr. Morgan, President Roosevelt took an active part by calling the three TVA directors to the White House to explain the charges and counter-charges. The President said he wanted the parties to the controversy to prove their respective allegation.

The Comptroller-General's office revealed that 4,887 items of expenditure, totaling $10,727,509, were being held up pending determination whether they were authorized. It was reported by the office that during 1936 and 1937 fiscal years 7,964 transactions, involving $15,542,459, had been questioned; of these 3,077 items, involving $4,814,950, were passed after explanation.

The present outbreak in the TVA board was precipitated when Dr. Morgan charged that in the marble claims of Senator George L. Berry of Tennessee he had opposed the "compromise" which his two co-directors were attempting to make with Senator Berry. Dr. Morgan charged that there "is a practice of evasion, intrigue and sharp strategy, with remarkable skill in alibi and the habit of avoiding direct responsibility which makes Machiavelli seem open and candid."

Westinghouse Realigns Industrial Department in Service Expansion

Powel, Stainback and Lester head up three divisions in move to serve industry better — Industrial, resale and industry engineering sections provide facilities to meet changing conditions in markets

A realignment of its industrial department in order to serve industry better is announced by Westinghouse Electric & Manufacturing Company. Three new departments, industrial, resale and industry engineering, have been formed to meet the changing conditions which have been taking place in industrial markets.

The three new industrial departments have been so organized as to answer better the needs of developments in industry. C. A. Powel, C. B. Stainback and Bernard Lester, well known in the industry, will head up the three new divisions.

Heads new department

Electrification of industries such as iron and steel, mining, chemical, petroleum and public works will be under the industrial department, headed by Mr. Stainback, formerly assistant manager.

The resale department will devote its facilities to servicing manufacturers whose products incorporate electrical equipment and other secondary distribution channels such as industrial agents and jobbers. However, those companies building equipment for a specific industry will remain the responsibility of the industrial department. Such activities as machinery electrification, appliance electrification and construction industries and contractors will be included in the new department. Mr. Lester, also assistant manager of the former industrial department, becomes manager.

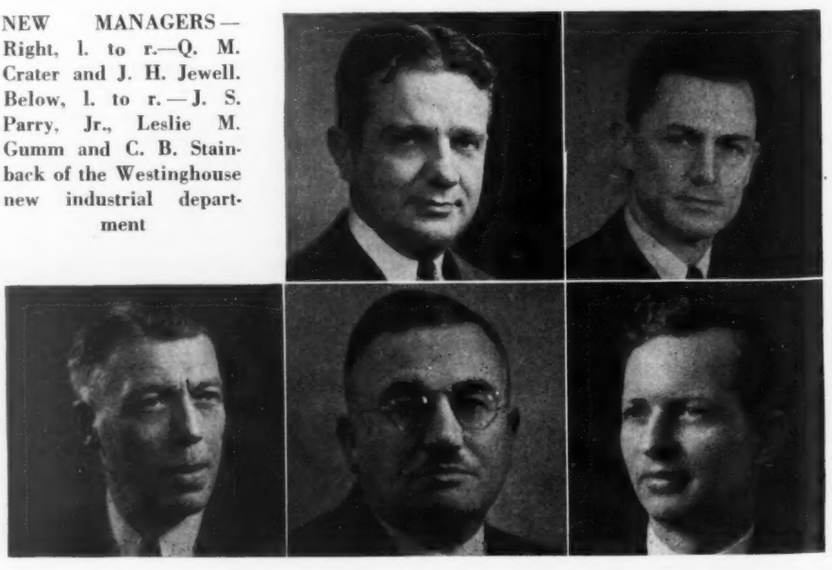
Backing up both departments with application engineers, the industry engineering department will provide a corps of engineers experienced in electrical problems of the several industries. In this capacity the department will have a true engineering approach to industry electrification and its engineers will be available for consultation and development work. Mr. Powel will be manager of the new department, which will also embrace the activities of the central station engineering department, previously headed by him.

Offices at East Pittsburgh

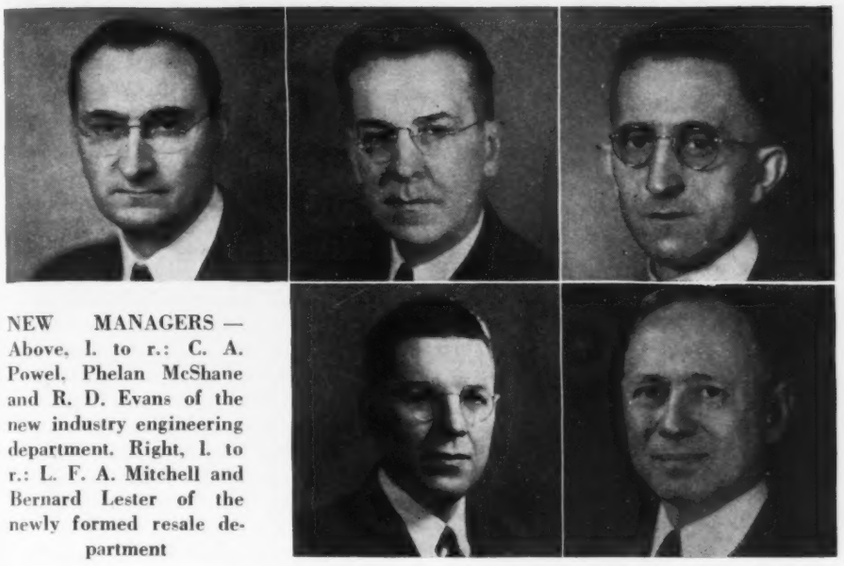
It was announced that these departments are all located at the company's East Pittsburgh offices. Mr. Lester will maintain his office at Pittsburgh.

Mr. Stainback, manager of the new industrial department, announced that the following will manage different sections:

Leslie M. Gumm, metal working section, will be in charge of electrification of steel mills and automotive plants. J. S. Parry, Jr., mining section; Q. M. Crater, petroleum and chemical section; J. H. Jewell heads a new section known as public works and communication, which includes also amusements and relations with architects and con-



NEW MANAGERS — Right, l. to r.—Q. M. Crater and J. H. Jewell. Below, l. to r. — J. S. Parry, Jr., Leslie M. Gumm and C. B. Stainback of the Westinghouse new industrial department



NEW MANAGERS — Above, l. to r.: C. A. Powel, Phelan McShane and R. D. Evans of the new industry engineering department. Right, l. to r.: L. F. A. Mitchell and Bernard Lester of the newly formed resale department

sulting engineers whose major work identifies them with the named industries; G. D. Bowne, who has been manager of the general mill electrification section, continues in that relationship. This section includes such important industries as paper, textile, food and rubber. J. R. Fulton heads the marine electrification section, which is responsible for the sale of electrical auxiliaries to the navy and merchant marine and shipbuilding companies and companies manufacturing equipment exclusively for shipbuilding.

Section managers named

Mr. Lester announced that the managers of the different sections of the resale department include: W. D. Turnbull, machinery electrification, the same responsibility he held under the former industrial department; J. M. Staples, appliance electrification section, responsible for the household, office and store appliance manufacturers' industries; L. F. A. Mitchell, construction section, responsible for general contractors, electrical wiring companies and heating and ventilating and other contractors.

Mr. Powel announced the following functions of the new industry engineering department: A. C. Monteith becomes engineering manager, central station section; R. D. Evans and C. F. Wagner become consulting transmission engineers. The industrial activities are divided among three sections—the metal working section, with G. E. Stoltz as manager; the mining, chemical and petroleum section, with Phelan McShane as manager, and the general mills and resale section, with C. W. Drake as manager. H. C. Coleman continues as manager of marine engineering section.

Communities Vote to Buy Power Units

Sixteen west Tennessee communities signified their willingness recently to buy the distribution and generating facilities of the West Tennessee Power & Light Company for the purpose of distributing TVA power.

Mayors and representatives of the municipalities specified in a resolution that they were ready to buy the facilities for prices determined on either of two bases: (1) Original cost less accrued depreciation computed on an age-life basis, or (2) reproduction cost new, less accrued depreciation computed on an age-life basis.

Mayor H. J. Foltz of Humboldt said a committee of six mayors had asked for a conference with John Wisdom of Jackson, Tenn., president of the company. If the power company is unwilling to sell, the resolution said, the municipalities would proceed with the construction of their own system.

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Sponsors Range Drive

The Electric Association of Kansas City, Mo., has opened a drive to sell 5,000 ranges during 1938. The campaign carries special cash bonuses of $5 per range and a trip to Mexico City for selling 50 ranges.

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Rehearing Set on WDA

Wisconsin Supreme Court has ordered a rehearing on its decision in January which held the Wisconsin Development Authority to be unconstitutional. New arguments will be presented April 15.

Opposes Tariff Cut on Electric Goods

In a brief filed with the Committee for Reciprocity Information in Washington on behalf of member companies, the National Electrical Manufacturers Association has requested that "no reductions in existing American duties, as applied to the products of the electrical manufacturing industry, shall be made in the pending reciprocal trade agreement with the United Kingdom, except with respect to products which shall be specified, and then only upon the basis of careful determination to assure that no serious injury to American interests will result."

The brief emphasizes that "any reduction in existing American tariff rates which would permit increased imports will primarily injure the concerns whose major products happen to be in those lines of interest to foreign exporters." This would be "particularly injurious in the case of the many smaller plants or limited line manufacturers, where any resulting loss of business through increased foreign competition would be a serious matter even though such increases might be small when viewed in terms of the total volume of business of the electrical manufacturing industry as a whole."

A study of 1,082 concerns in the industry showed that less than 4 per cent of them engage in 5 or more out of the 70 major product groups coming within the association's scope.

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Missouri Utility Group to Hold Annual Meeting

The annual convention of the Missouri Association of Public Utilities will be held April 20-22 at the Hotel Jefferson, St. Louis, Mo. Among the speakers will be W. C. Beckjord, Columbia Gas & Electric Corporation; L. A. Hawkins, General Electric Company; Cleveland A. Newton, Mississippi Valley Association; N. T. Veatch, consulting engineer of Kansas City, Mo.; L. H. Egan, Union Electric Company, and J. B. Wilson, Laclede Gas Light Company.

Among the subjects will be: "Fundamental Research and Industrial Progress," "National Legislation Affecting Industry" and "What the Manufacturer Is Doing for Economical Utility Operations." A safety meeting and round-table discussion of accident prevention will open the convention. The annual open forum for the discussion of timely utility subjects will be held on the afternoon of April 22.

Discuss Dielectric Tests at Doble Meet

Improvements in the technique of testing insulation by the dielectric loss and power-factor method featured the recent fifth annual conference of Doble Engineering Company clients at its Medford Hillside laboratory near Boston, which was attended by 100 persons, including representatives of 37 power companies and of leading electrical manufacturers.

One large manufacturer announced that the dielectric loss test will soon become a standard shop test on all new power transformer windings. This test featured a session for the first time open to a group of transformer makers.

A refinement in bushing test technique was disclosed in a so-called dielectric loss collar test which reveals incipient faults sometimes masked by the conventional tests. Evidence was presented to show that lightning arresters offer a new field for dielectric loss tests of both station and distribution types. It was indicated that some forms of operating hazards, such as corroded gaps, can be detected by this method.

The technique of generator and cable testing by the above method is also being steadily expanded. One paper covered tests on a 1,500-kw. generator winding up to the point of destruction, and another reviewed field testing of 65 cables of the 15-kv. belted paper and 33-kv. "H" types, with lengths up to 3,000 ft. Examples of defective potheads found by over-all cable tests were cited.

The use of oil circuit breaker mechanism travel and contact resistance tests as supplements to over-all dielectric loss tests was covered in papers from operating companies. This combination of tests facilitates making maintenance a function of external tests. Papers were presented by F. D. Brook and E. W. Whitmer, American Gas & Electric; O. E. Fawcett, West Penn Power; G. G. Law, Dayton Power & Light; E. L. Schlottere, Philadelphia Electric; S. Coxhead, Central Illinois Electric & Gas; R. M. Seitz, Cincinnati Gas & Electric; R. H. Mertz, Detroit Edison; W. J. Brigegam, E. M. Gilbert Engineering Corporation; W. C. Sealey, Allis-Chalmers; F. I. Manvel, L. V. Bewley and L. Wetherill, General Electric; G. A. Burr and L. O. Dorfman, Westinghouse; F. L. Brandt, Ohio Brass, and members of the Doble staff.

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Approve Utility Franchise

Citizens of St. Augustine voting in a municipal election last week approved granting a new franchise to the Florida Power & Light Company. The vote was 1,652 in favor of granting the new franchise and 942 opposed. The total number of ballots cast represented slightly more than half the qualified voting strength of the city. The city commission had previously approved the franchise.

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Against Minimum Bill

A bill has been introduced in the New York Assembly which would eliminate all minimum bills on the use of electricity. The measure proposes that no electric corporation shall make or impose on residential customers a minimum charge except as based on energy consumed by such residential customers.

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New Substation Planned

Kentucky-Tennessee Light & Power Company will start construction of a new substation in Clarksville, Tenn., despite the fact that Mayor W. D. Hudson predicts that his city will have a municipally owned distribution system served by TVA before next June. Three large transformers will be installed in the new substation.

Niagara Hudson Adds to Rural Power Lines

A construction program calling for the expenditure of about $18,000,000 will be undertaken by Niagara Hudson Power Corporation system companies. This amount includes the steam-electric generating station at Oswego, N. Y.,

The report covering 1937 operations points out during the year 1,632 miles of rural lines were built and energized. During the past three years 4,066 miles of rural lines were built. The system now has 13,800 miles of rural lines serving 40,318 farm and approximately 142,500 non-farm customers. It is planned to construct 800 miles of rural lines this year. This will mean that 93 per cent of the rural territory is electrified.

For the ninth consecutive year the system led the world in the sale of electric energy. Sales totaled 7,172,828,930 kw.-hr., an increase of 11.2 per cent over 1936. Through elimination of fifteen companies last year by recapitalization and refunding operations annual savings of more than $1,000,000 were effected in interest and preferred dividend requirements.

The consolidated statement showed operating revenues of $87,561,816, against $80,865,557 in 1936. Net income was $10,502,271, against $10,161,783.

Taxes totaled $14,359,576, an increase of $2,072,344, or 16.9 per cent. Operating revenues were up only 8.3 per cent. Taxes now constitute 16.4 cents of every dollar revenue.

The report pointed out that funds held for future construction amounted to $13,275,442 at the end of 1936.

Floyd L. Carlisle, chairman, and Alfred H. Schoellkopf, president, stated that at the end of the year 11,300 men and women were working with the companies, an increase of 3.7 per cent. Wages and salaries totaled $20,200,000, an increase of 14.3 per cent.

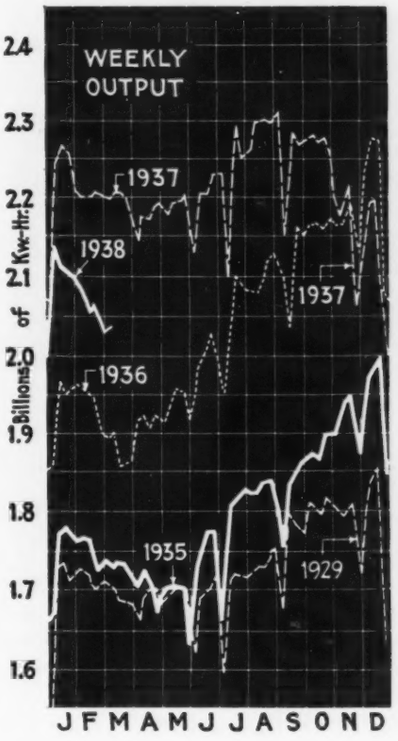
DOBLE CONFERENCE—More than 100 representatives of power companies and of leading electrical manufacturers gathered at the recent fifth annual conference of Doble Engineering Company to discuss testing insulation technique

Output Resists Down-Trend

Production rises slightly—7.5% under 1937, 6.9% over 1936—Middle Atlantic near last year's

Energy production by the electric light and power industry during the week ended March 5 moved slightly upward from the preceding week to 2,035,673,000 kw.-hr., according to the Edison Electric Institute. While output continues to be less than in 1937 the disparity decreased from 8.0 per cent to 7.5 per cent. The new figure is 6.9 per cent greater than that for the corresponding period of 1936. Although the upward turn was small it marks a second interruption of the recent decline.

Regional comparisons show that operations remain closest to the 1937 level in the Middle Atlantic states, where the decrease was only 1.1 per cent and where it has not exceeded 2.4 per cent at any time in the present movement. On the Pacific coast, also, the gap is narrow and appears to be closing. New England is still low but improvement is indicated. Further losses occurred in the Central Industrial area, now 15.3 per cent under 1937.



Weekly Output, Millions of Kw-Hr.

1938	1937	1936
Mar. 5 . 2,036	Mar. 6 . . 2,200	Feb. 29 . . . 1,903
Feb. 26 . . 2,031	Feb. 27 . . . 2,207	Feb. 22 . . . 1,942
Feb. 19 . . 2,059	Feb. 20 . . . 2,212	Feb. 15 . . . 1,950
Feb. 12 . . 2,052	Feb. 13 . . . 2,200	Feb. 8 . . . 1,952
Feb. 5 . . 2,082	Feb. 6 . . . 2,201	Feb. 1 . . . 1,962
Jan. 29 . . 2,099	Jan. 30 . . . 2,215	Jan. 25 . . . 1,956
Jan. 22 . . 2,109	Jan. 23 . . . 2,257	Jan. 18 . . . 1,950
Jan. 15 . . 2,115	Jan. 16 . . . 2,264	Jan. 11 . . . 1,971

Per Cent Change from Previous Year

Region	Week Ending Mar. 5	Feb. 26	Feb. 19
New England	− 9.8	−11.0	−10.3
Middle Atlantic	− 1.1	− 1.3	− 2.1
Central Industrial	−15.3	−14.9	−13.8
West Central	− 4.9	− 3.4	− 0.2
Southern States	− 6.0	− 5.0	− 3.9
Rocky Mountain	−14.4	−12.9	− 8.7
Pacific	− 1.4	− 3.5	− 1.6
United States	− 7.5	− 8.0	− 6.9

Mississippi Utility Asks Extension of Franchise

In view of the signing of a contract to furnish power for a proposed million-dollar rubber tire manufacturing plant at Natchez, Miss., the Mississippi Power & Light Company has asked a 25-year extension of its franchise by the community, Rex I. Brown, president, announced.

Mr. Brown stated that if the franchise is extended the utility proposed to construct a new high power line from Sterlington, La., to Brookhaven and into Natchez, at an estimated cost of approximately $1,000,000.

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Hearing Set on Conowingo

FPC has ordered a hearing to be held on March 21 on matters involved in the determination of the actual legitimate original cost of the initial Conowingo project, located on the Susquehanna River near Port Deposit, Md. Protests filed by the joint licensees, Susquehanna Power Company and Philadelphia Electric Power Company, against the suspension of certain items of claimed costs are the principal matters to be considered at the hearing.

The initial installation consists of seven units each of 54,000 hp., making an aggregate capacity of 378,000 hp. installed. The chairman of both the Public Service Commission of Maryland and of the Pennsylvania Public Utilities Commission have been invited to send representatives.

•

Mississippi Cities Vote for TVA Electricity

Columbus, Miss., has signed a 20-year contract for TVA power. The City Council has ordered the Beard Engineering Company to proceed with plans and specifications for construction of a municipal distribution system. The system will be built, Mayor Harris stated, unless the Mississippi Power & Light Company agrees to sell its properties "at a fair price."

Water Valley, Miss., cast an overwhelming vote for TVA power. The vote was 526 to 45 in favor of entering into a 20-year contract with TVA. At the same time, representatives of Aberdeen, Houlka, Houston and Startville held a meeting at Aberdeen and announced plans for seeking contracts with the Authority.

•

Power Output Shows 5% Loss in January

Production of electricity for public use in the United States during January, 1938, amounted to 9,334,986,000 kw.-hr., a decrease of 5 per cent from January last year, according to the Federal Power Commission.

This decrease, which was mainly in the eastern section of the country, follows one of 3 per cent in December, 1937, when output for the first time in recent years failed to equal the corresponding amount in the preceding year. Average daily production was 4.2 per cent less than in December, the normal change being a decrease of 0.2 per cent. Water power accounted for 38 per cent of the total, against 39 per cent in January, 1937.

Fuel consumption included 3,315,146 tons of coal, 1,083,613 bbl. of fuel oil and 13,515,000,000 cu.ft. of natural gas, as compared with 3,411,339 tons, 1,767,136 bbl. and 11,138,000,000 cu.ft. a year ago.

The above data exclude the output of 302,520,000 kw.-hr. by electric railways, electrified railroads and certain state and federal plants not producing energy for public use.

A total of 1,530,872,000 kw.-hr., or 16.4 per cent of the total generated, was reported as crossing state lines. In a number of states imports and exports, although large, approximately balanced, from which it may be inferred that much of the energy crossing state lines was for interchange. Outstanding exceptions were Nevada, which used only 8 per cent of energy generated within its borders; Indiana, using 79 per cent; Louisiana, 82 per cent. Missouri used 105 per cent more than it generated and California 19 per cent.

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Litigation Delays Project

Work on the Santee-Cooper $37,500,000 power project will not start until litigation is cleared up, according to Mayor Burnett Maybank of Charleston, S. C., chairman of the South Carolina Public Service Authority.

Utility Stocks Decline in Week

Electric power and light stocks this week lost the ground they had gained during the preceding two weeks as the "Electrical World" index dropped 0.7 points. Index this week, 25.4; previous week, 26.1; corresponding week a year ago, 38.2

New England Power Reduces Dividends

Directors of New England Power Association have declared a dividend of $1 a share on the 6 per cent preferred stock and 33 1/3 cents a share on the $2 dividend preferred, both payable April 1 to holders of record March 15. Regular quarterly dividends are $1.50 a share and 50 cents a share respectively.

In commenting on the reduction in preferred dividends, Frank D. Comerford, chairman of the board, pointed out the drop in earnings during the latter part of 1937 as compared with the corresponding period of the preceding year. He said:

> This abrupt change in earnings is particularly attributable to the business depression which began in New England during the latter part of the summer of 1937 and to the cumulative effect of substantial rate reductions, increased labor costs and taxes. Beginning in September, 1937, electric primary production commenced a major decline and in December, 1937, reached a low point of between 15 per cent to 20 per cent below the similar period of 1936. This decline seems to have flattened out and currently is running nearly 15 per cent below the early part of 1937. There is no present indication to support an expectation of immediate improvement, and with the approaching seasonal decline of electric consumption as well as the current reduced business activity, it was decided that preferred dividends should not now be declared at the full rates.

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Settle Relief Taxes Suit

Thirteen utility companies in the Consolidated Edison Company of New York, Inc., system recently paid the city $1,220,197 in settlement of pending litigation over emergency relief taxes. Tax claim resulted from deficiency assessments made by New York against the companies in addition to the emergency relief taxes paid voluntarily by the companies; claim covered period from September 1, 1933, to August, 1934.

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$10,000,000 Issue Planned by Utility

New York & Queens Electric Light & Power Company has applied to the New York Public Service Commission for permission to issue $10,000,000 first and consolidating mortgage bonds at 3¼ per cent interest, maturing in 1968. Proceeds would be used to pay Consolidated Edison Company $7,000,000 advanced to the Queens company for capital expenditures and the balance for additions, improvements and betterments to plant and distribution system already made and to be made.

The petition to the commission points out that net capital additions to company property during the period from September 30, 1935, to December 31, 1937, which have not been made the basis for issuance of any securities, amount to $8,550,906. Most of the funds to meet these expenditures—$7,000,000—was obtained by borrowing on open account from Consolidated Edison Company.

"During the period between December 31, 1937, and June 30, 1939," says the petition, "your petitioner will be required to make additions, extensions and improvements to its plant, equipment and distribution system. It is estimated that the reasonable expenditures for such purpose during said period will exceed the retirements or other appropriate deductions from fixed capital account during such period by more than $5,006,000. Of this amount approximately $3,118,000 will, your petitioner believes, be expended during the year 1938."

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Standard Gas Plan Confirmed by Court

Formal order of confirmation of a plan of reorganization of Standard Gas & Electric Company has been signed by Judge John P. Nields in the United States District Court for the District of Delaware at Wilmington, according to a statement by Bernard W. Lynch, president of the company.

In the plan it is stated that upon consummation of the plan the company proposes to register as a holding company with the SEC under the public utility act of 1935.

Mr. Lynch stated that preparation of the various instruments and completion of other steps necessary to consummate the plan, in accordance with the order of confirmation, will require a further brief period of time.

The company has agreed to advance a program for the reduction of its funded debt soon after the conclusion of the reorganization proceedings.

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Requests Note Exemption

Greenville Electric Light & Power Company, Greenville, Ohio, a subsidiary of United Public Utilities Corporation, has filed an application under the holding company act for exemption from the requirement of filing a declaration covering the issuance of three promissory notes. The notes are in the amount of $354,332, $146,000 and $57,209, each bearing 6 per cent interest and being payable on or before January 1, 1945. The first two notes are to be issues in substitution for certain demand promissory notes outstanding, and the third will be used to reimburse applicant for certain capital expenditures.

Earnings Reports (Utilities)

	Net Income 1937	1936
*Standard G. & E. and subs.	$3,337,170	$3,571,406
*Southern Calif. Edison and subs.	12,058,469	12,837,813
*Boston Edison	5,381,879	5,170,907
*Duke Power	4,660,474	4,860,591
*Milwaukee Elec. Rwy. & Lt.	1,997,983	2,647,606
*Tampa Electric	1,458,155	1,372,282
*Connecticut Lt. & Pwr.	4,173,644	4,531,473
*Union Elec. Co. of Mo.	8,193,614	6,744,341
*L'ville G. & E. (Del.) and subs.	1,178,452	1,971,563
*Toledo Edison	2,164,648	1,851,548
*Potomac Elec. Pwr.	4,886,974	4,446,306
*San Antonio Pub. Serv.	858,300	849,030

* Twelve months ended December 31.

Woolworth Installs Electric Precipitation

First retail store to utilize electrostatic dust precipitation is the newly opened F. W. Woolworth & Company store on Fifth Avenue, in New York City. This installation, capable of handling 30,000 c.f.m. of air at an estimated operating cost of one cent per 1,000,000 cu.ft. is said to remove 99 per cent by weight of all particles from the air.

Electrically the installation is rated at 500 watts and consists of 40 "Precipetron" cells, each capable of cleaning 750 cu.ft. of air per minute. The Precipetron is a development of Westinghouse research engineers.

The desirability of having clean air, clean merchandise and healthful conditions for employees, coupled with the fact that the installation could be made to pay for itself over a period of a few years, was advanced as the reason for making the installation by Chief Engineer W. W. Turner of F. W. Woolworth & Company. By eliminating carbon and entrained dust from the air it is estimated that the time between store painting periods can be increased from one to two years, thus saving about $2,000. The first Precipetron installation (ELECTRICAL WORLD, October 23, 1937, page 1367) was made in the Field Building, Chicago, and was confined to offices only. The Woolworth installation is the first installation from which the public will benefit directly.

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Arizona to Oppose Move to Lower Boulder Rates

Notice has been given by the Arizona congressional delegation that any change in the Boulder power set-up which would result in a reduction of the state's revenue under present laws would be opposed.

Senators Henry Ashurst and Carl Hayden and Representative John R. Murdock asserted they would oppose rumored interior department plans for a reduction in power costs to the City of Los Angeles and other southern California users.

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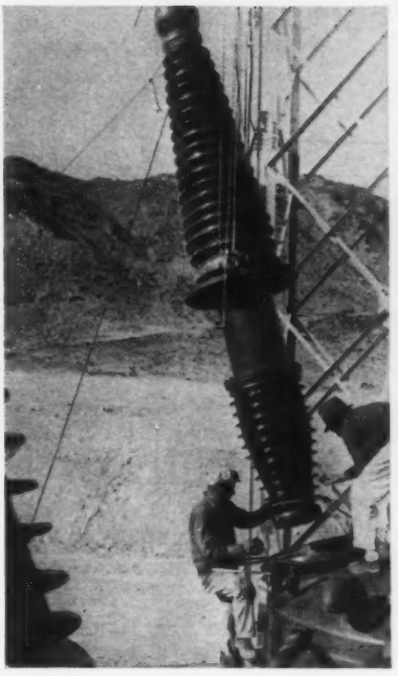
Unite to Get TVA Power

Six middle Tennessee counties have united to form a corporation for the purpose of bringing TVA power into the rural sections of the member counties. Counties represented in the new corporation are: Robertson, Sumner, Montgomery, Stewart, and parts of Davidson (Nashville) and Cheatham.



WORKMEN LOWER A BUSHING into a circuit breaker of 2,500,000-kva. rated interrupting capacity at mile No. 133 on the 230-kv. transmission line from Boulder Dam to five aqueduct pumping plants of the Metropolitan Water District of Southern California. Transformers at this station will drop voltage to 6,900 to operate the three 4,400-h.p. motors making up the initial installation at Iron Mountain pumping plant

Lighting Fixture Dealers Form National Association

Public education on the need for adequate outlets to assure efficient lighting is included among the objectives of the National Lighting Fixture Guild, recently organized at a meeting of fixture dealers and jobbers in New York City.

Officers elected for the coming year include: A. L. Oppenheimer, Enterprise Electric Lighting Fixtures, Inc., Cleveland, Ohio, president; John Donovan, Service Electric Manufacturing Company, Boston, Mass., and Harold B. Carpenter, Whiffen Electric Company, White Plains, N. Y., vice-presidents. George E. Henry has been appointed business secretary, with headquarters at 630 Fifth Avenue, New York, N. Y.

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Raise Utility Assessments

More than $2,500,000 has been added to the taxable bases in Allegany and Garrett counties through reassessment of public utility holdings, M. J. Lindsay, supervisor of assessments of the State Tax Commission, announced.

California Authority Makes Counter Plan

Seeking to insure a market for Shasta Dam power, if and when available, the California Water Authority offered to withdraw its opposition to the issuance of a preliminary permit for the Feather River hydro plants proposed by the Pacific Gas & Electric Company, provided the permit contained a provision protecting the future state-owned project. In making this stipulation at a hearing before Examiner F. A. Hampton of the Federal Power Commission in San Francisco, recently, engineers for the authority suggested that additional steam capacity, while costing the company more, would be more desirable for the fullest possible utilization of the Shasta power in 1943.

With 50,000 kw. of new steam capacity scheduled for completion this year, 80,000 kw. additional under construction and 40,000 kw. tentatively planned, Pacific Gas & Electric Company contended that load requirements in 1941 would require the availability of the full capacity of the 68,000-kw. Cresta plant on the Feather River. Engineering studies indicated that this hydro power would cost less in over-all system operation than more steam capacity. If the Shasta plant is not completed by 1943 (State Water Authority engineers could give no assurance that it would be), then load growth would demand the completion of the 80,000-kw. Pulga plant, P.G. & E. engineers testified.

Bidwell Municipal Utility District and various irrigation interests backed the State Water Authority in its stand on the grounds that water costs would be increased if the Shasta Dam power could not be sold when available. Examiner Hampton allowed all parties until April 1 for the submission of briefs and fifteen days thereafter for rebuttal.

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Buzzard Roost Bids

Sealed bids for the construction of the earthen dam, power house, spillway and other appurtenant structures for the Buzzards Roost development of the Greenwood County (S. C.) hydro-electric project will be received at the Greenwood County courthouse until noon March 22, E. L. Brooks, chairman of the finance board for Greenwood County, has announced.

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New Hampshire Unit Exempt

SEC has issued an order declaring that Central New Hampshire Power Company has ceased to be a holding company under the utility act.

New REA Allotments Made in February

Among the allotments announced by the Rural Electrification Administration during the month of February are the following:

ILLINOIS—Illinois Electric Co-operative, $186,000, 173 miles of line, 447 customers in Champaign, McLean and Ford counties. Source of power will be Central Illinois Public Service Company.

OHIO—North Central Farm Bureau Electric Co-operative, Inc., $110,000, 100 miles of line, 282 customers in Seneca and Wyandot counties. Carroll Electric Co-operative, Inc., $132,000, 135 miles of line, 367 customers in Carroll County. Source of power will be Minerva municipal plant or Ohio Power Company. Belmont County Farm Bureau Co-operative Association, Inc., $128,500, 120 miles of line, 324 customers in Belmont and Monroe counties. Source of power will be Ohio Power Company. Paulding-Putnam Rural Electric Co-operative, Inc., $125,000, 130 miles of line, 425 customers in Paulding, Putnam and Defiance counties. Source of power is Ohio Power Company. Licking Rural Electrification Co-operative, Inc., $135,000, 143 miles of line, 375 customers in Licking and Knox counties. Source of power is Ohio Power Company.

TEXAS—Wood County Electric Co-operative, Inc., $103,000, 108 miles of line, 423 customers in Wood county. Rusk County Electric Co-operative, Inc., $121,000, 107 miles of line, 444 customers in Rusk and Panola counties.

MICHIGAN—Presque Isle County Electric Co-operative Association, $112,000, 100 miles of line, 335 customers in Presque Isle, Montmorency, Alpena and Cheyboygan counties. Source of power is Alpena Power Company.

MISSISSIPPI—Tallahatchie Valley Electric Power Association, $220,000, 227 miles of line, 608 customers in Tate, Panola, Tallahatchie, Yalobusha and Lafayette counties. Source of power is TVA.

NORTH CAROLINA—Co-operative being formed, 21 Sampson, $145,000, 142 miles of line, 440 customers in Duplin, Sampson, Pender and Bladen counties. The project has also been allotted $41,000 to install a generating plant in the vicinity of Ivanhoe. Edgecombe-Martin County Electric Membership Corporation, $111,000, 107 miles of line, 348 customers in Edgecombe, Martin and Pitt counties. Source of power is Tarboro municipal plant.

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G.E. Gives Coffin Awards to Forty Employees

Forty of the General Electric Company's 70,000 employees received the highest honors the company bestows—awards by the Charles A. Coffin Foundation for outstanding contributions to the electrical industry. Among awards given was one to a shop employee for his outstanding record as a contributor of new ideas for the improvement of quality in products, of more efficient methods, and material savings. This employee submitted 214 new ideas during the past ten years and saw 50 of them adopted.

Awards were divided among nineteen factory men, fifteen engineers, three salesmen and three administrative employees.

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Louisville Gas & Electric Celebrates Its Centennial

Commemorating a century of service, the Louisville Gas & Electric Company recently published in the Louisville *Courier-Journal* an elaborate 32-page rotogravure supplement depicting and relating the history of the city and of the company since 1838, when its ancestor, the Louisville Gas & Water Company, was incorporated.

According to the supplement, the first public electric utility service in Louisville was the Brush Electric Light Company, organized November 15, 1881.

Meetings

Northwest Electric Light and Power Association—Annual conference, business development section, Medford, Ore., March 16-18. Annual meeting, engineering and operation section, Vancouver, B. C., April 20-23. Berkeley Snow, executive secretary, 707 Spaulding Bldg., Portland, Ore.

Missouri Valley Electric Association—Sales and rural service conference, Kansas City, Mo., March 17-18. Engineering conference, Omaha, Neb., April 7-8. I. D. Pettigrew, assistant director, 1527 Sharp Building, Lincoln, Neb.

Oklahoma Utilities Association — Annual meeting, Biltmore Hotel, Oklahoma City, Okla., March 21-22. Kate A. Niblack, acting secretary, Oklahoma Utilities Association, 625-626 Biltmore Hotel, Oklahoma City, Okla.

Edison Electric Institute—Sales committee, Edgewater Beach Hotel, Chicago, Ill., March 28-31. Bernard F. Weadock, managing director, 420 Lexington Avenue, New York, N. Y.

Midwest Power Conference—La Salle Hotel, Chicago, Ill., April 13-15. L. E. Grinter, Dean, Graduate Division, Armour Institute of Technology, Chicago, Ill.

Greater New York Safety Council—Annual convention, Hotel Astor, New York, April 19-21. Julien H. Harvey, executive vice-president, 60 East 42nd Street, New York, N. Y.

Missouri Association of Public Utilities—Annual convention, Jefferson Hotel, St. Louis, Mo., April 20-22. Jesse Blythe, assistant secretary, Merchants Bank Bldg., Jefferson City, Mo.

Southeastern Electric Exchange — Annual conference, Edgewater Gulf Hotel, Biloxi, Miss., April 21-23. John Talley, executive secretary, 308 Haas-Howell Building, Atlanta, Ga.

Electrochemical Society — Spring meeting, Savannah, Ga., April 27-30. Dr. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Association of Iron and Steel Engineers—Annual spring conference, Baltimore, Md., April 28-29. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

Maryland Utilities Association — Annual meeting, Lord Baltimore Hotel, Baltimore, Md., April 29. E. J. Roche, secretary, 55 E. Washington St., Hagerstown, Md.

High Duties Affect Electric Products

Electrical goods are included among the various products affected by the sharply increased duties in Mexico recently announced, most of the new rates being about double those previously in effect.

Electrical products affected and the new rates, compared with the old, as given by the U. S. Department of Commerce: Iron refrigerators and those of wood with or without common metal lining, weighing up to 200 kilos, 1.00 peso per legal kilo, against 0.50; weighing more than 200 kilos, 1.00, against 0.45; machinery and apparatus of any kind, imported in one or in various lots, when the total gross weight is up to 50,000 kilos, 0.07 pesos per gross kilo, against 0.03; up to 250,000 kilos, 0.05, against 0.02; up to 500,000 kilos, 0.04, against 0.015; electric dry cells, 1.40 pesos per legal kilo, against 0.80; vacuum cleaners, 4.00 pesos per legal kilo, against 1.50; electric meters, when each weighs up to 25 kilos, 1.50 pesos per gross kilo, against 0.60.

New duties are to be operative until April 30, 1938, after which they are to be decreased to a level generally above the old duties. At present rates of exchange a peso is worth about 84 cents.

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Two $500 Prizes Offered by Water Heating Council

The National Electric Water Heating Council Modern Kitchen Bureau, sponsored by the E.E.I. and the N.E.M.A., will award two prizes of $500 each to the utility executives or engineers who submit the best papers on the subject "Advisability of Competitive Water Heater Rate and Advantages of the Water Heater Load."

The contest is open to executives and engineers of operating utilities in the United States. All entries must be postmarked before midnight of May 1. It was stated that in case of ties duplicate prizes will be awarded.

•

Pushes Water Rights Case

Michigan Conservation Commission has announced it is "sympathetic" with industrial development along the Ontonagon River, but has asked the Attorney-General to proceed with a suit to determine the Copper District Power Company's right to divert the flow of the river's middle branch.

The power company was authorized by the Ontonagon County board of supervisors to proceed with plans to divert water from Agate and Bond Falls, but the Attorney-General ruled that the program would destroy the beauty of the falls and violate inherent rights of the people.

To Measure—DIMENSIONS ELECTRICALLY

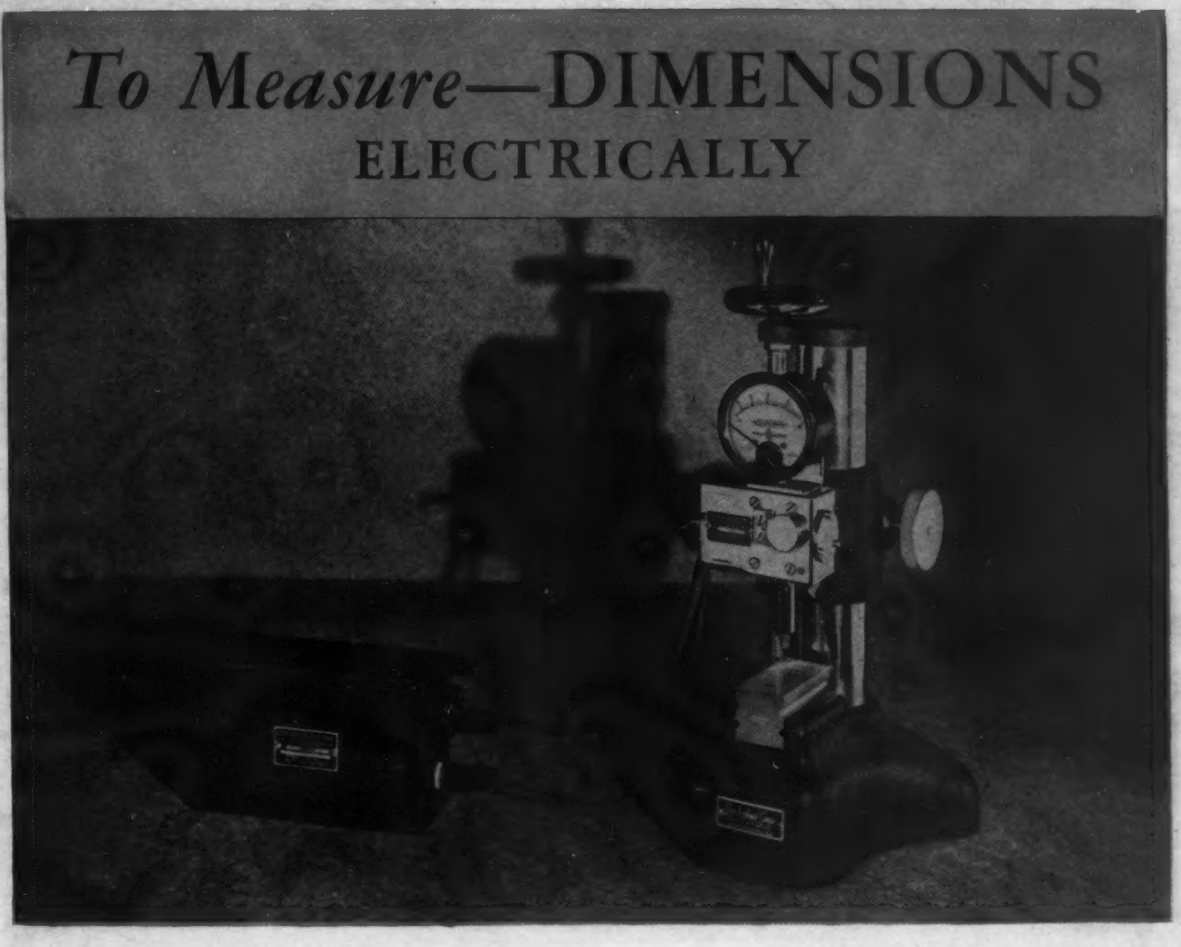

Photo courtesy Pratt & Whitney Co.

NOT the distance to the stars, but linear dimensions so minute that they are equally difficult to measure—such as 1/1,000,000 inch.

The electric gauge can measure them.

This simple, practical, highly accurate device, only recently developed by G-E instrument engineers, has already proved its worth. In the words of one user, "it has contributed more to the success of our product than any other single equipment."

In various forms, the electric gauge has found extensive use—for the inspection of finished parts . . . for the measurement of strain and of stress on bridges and in locomotives, and of pressure on the rolls of a steel mill . . . for the measurement of the thickness of enamel and plating on flat surfaces and of metal foil, and of many other materials.

Distance is but one of the many fields to which General Electric engineers have brought the science of accurate measurement. G-E instruments measure sound, light, vibration, color, and even the power of lightning. There are also instruments to measure current, voltage, resistance, watts, frequency, power-factor—in dozens of standard styles, indicating and recording, in ratings to fill every need.

For almost fifty years General Electric has been a leader in the design and manufacture of electric instruments. Its engineers have brought to measurement the experience gained in every field of electrical endeavor. If you have a problem that involves measurement of any quantity, remember General Electric, Schenectady, N. Y., as

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

430-84

Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Maintain Accurate Meter Transformers

By HARRY G. HAMMOND
Meter Standards Laboratory
Detroit Edison Company

Relative instantaneous polarities of primary and secondary terminals of both current and potential instrument transformers owned by the Detroit Edison Company are marked with white paint. Polarities are checked and remarked, if necessary, when the transformers are tested. They are inspected to be sure that each is equipped with necessary bolts and nuts and solderless lugs and short-circuiting wires for current transformers. Ratios are stenciled on current transformers so as to be visible from the floor, no matter in what position the transformer may be installed. Transformers removed from service are repaired and painted, if necessary, before tests are made.

First each transformer is given an insulation test by applying twice-rated primary voltage plus 1,000 volts between the primary and secondary windings and between the primary winding and core for one minute. A suitable tag is attached to each transformer giving information on date of test, O.K., or nature of failure, name of tester.

Accuracy test on current transformers consists of ratio and phase-angle determination by means of the Silsbee current-transformer testing set at 10 and 75 per cent of rated amperes. Limits of error are 0.5 per cent in ratio and ten minutes in phase-angle from the average ratio and phase-angle curve of the particular type of transformer under test. Any transformer found outside these limits is referred for special investigation.

All instrument voltage transformers are compared with a standard transformer by means of a Leeds & Northrup testing set at 115 volts secondary voltage. Limits of error are 0.5 per cent in ratio and ten minutes in phase-angle from the average ratio and phase-angle curve of the particular type of transformer under test. Any transformer found outside these limits is referred for special investigation.

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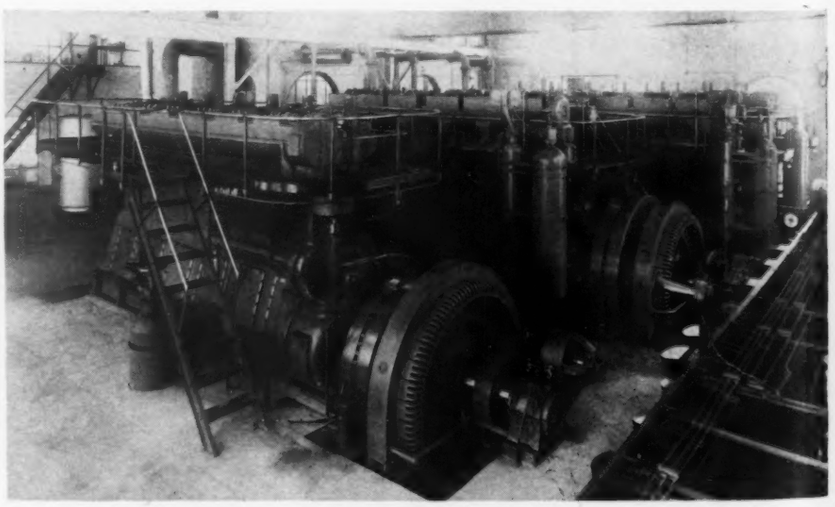
City Diesel Shows 9-Mill Energy Cost

In Hudson, Mass., the town lighting department has been operating a Diesel-driven generating plant since 1928, and the reports of the department to the state Utilities Commission indicate that in the 1932-36 period net production costs per kilowatt-hour have ranged between 8 and 9 mills with a load factor running between 37.7 and 44.1 per cent. During this time the plant operated four units aggregating 3,675 hp., with annual peaks running between 1,370 and 2,320 Kw. No energy was purchased and the installation presents an unusual example of a self-contained plant which is operated independently of adjacent power systems, serving some 3,000 residential customers in Hudson and Stow, a diversified industrial load, and within about 35 miles of Boston. Four hundred electric ranges are in use and commercial and street lighting services are well developed.

Extended investigation led the town to decide to replace the existing rapidly obsoleting steam station with McIntosh & Seymour vertical, single-acting, 4-cycle Diesel equip-



Hudson, Mass., Diesel units operated in the five-year period studied. A fifth machine is undergoing final test at this writing before entering routine service

BETTER ACCURACY—HIGHER INSULATION

New 5,000-VOLT

INDOOR CURRENT TRANSFORMER

THE new JW-1 5000-volt indoor current transformer — superior even to the WF-12 which it supersedes. To operating men interested in metering, the statement speaks for itself. The JW-1 is an outstanding transformer, with better accuracy and higher insulation, designed for dependable metering.

ACCURACY easily falls within the highest NEMA rating of ¼ X, ¼ Y, and ¼ Z at 60 cycles. Features are a new high-permeability steel, the Wilson scheme of compensation, narrower test limits, and closer manufacturing control. The result is a more uniform product, with ratio and phase-angle errors reduced to a point where they may be disregarded for even the highest grade of commercial metering. High mechanical and thermal capacity make the JW-1 suitable for relay applications.

INSULATION is equivalent to the 2.2-inch test gap, which meets the normal standard insulation level for the 5000-volt class with ample margin.

MECHANICAL FEATURES are a secondary short-circuiting switch that gives positive protection . . . polarity and nameplate markings that are always legible . . . primary and secondary terminals copper-brazed to the windings to form strong, unbreakable joints . . . dimensions that make it interchangeable with the WF-12.

For further details on the new JW-1 call the nearest G-E office or write for a copy of Bulletin GEA-2432. General Electric, Schenectady, New York.

GENERAL ELECTRIC

420-49

Hudson, Mass., Diesel Plant Operations

	1932	1933	1934	1935	1936
Kilowatt-hours generated	4,530,000	5,135,900	5,672,400	6,771,200	7,774,300
Kilowatt-hours used by plant	424,599	592,122	676,383	530,042	755,770
Kilowatt-hours net at bus	4,105,401	4,543,778	4,996,017	6,251,158	7,018,530
Maximum load in kw	1,370	1,500	1,470	1,880	2,310
Average load in kw	516	585	648	773	885
Load factor in per cent	37.7	39.0	44.1	41.1	38.4
Fuel oil burned, gals	385,327	433,188	454,330	551,189	607,435
Production Expenses					
Labor	$15,912	$14,846	$19,228	$18,854	$19,299
Fuel	12,439	14,929	20,057	21,428	22,817
Lubricants	2,004	1,844	2,249	3,032	3,778
Miscellaneous supplies	1,100	1,709	1,482	1,707	1,507
Water	164	269	224	117	457
Maintenance of internal combustion equipment	560	1,132	1,152	1,209	1,687
Fuel system	.....	.....	539	643	551
Other maintenance	2,416	1,591	378	620	401
Total	$34,595	$36,320	$45,309	$47,610	$50,497
Production cost summary per net kilowatt-hour, mills					
Labor	3.88	3.27	3.85	3.04	2.75
Fuel	3.04	3.29	4.00	3.45	3.25
Miscellaneous	1.51	1.44	1.19	1.16	1.18
Total	8.43	8.00	9.04	7.65	7.18

ment and in 1928 a contract was entered into for three units, a fourth being added in 1932. These machines were operated consistently during the five-year period covered in the accompanying table. The listing:

	Each Generating
1 675-hp. air-injecting engine, 6 cylinders, 17 x 24 in., 225 r.p.m.	575 kva.
2 900-hp. air-injecting engines, 8 cylinders, 17 x 24 in., 225 r.p.m.	770 kva.
1 1,200-hp. solid injecting engine, 6 cylinders, 20 x 24 in., 277 r.p.m.	1,044 kva.

General Electric Company provided the generating units, all of which deliver 2,300 volts at 60 cycles to the station bus. All are three-phase generators with chain-driven exciters and are direct-connected to the Diesel engine driving each main machine. There are one 460-kw., one 835-kw. and two 615-kw. generators, making a total plant rating up to 1937 of 2,525 kw. This fall a fifth Diesel has been added of 1,480-hp. rating, driving a 1,000-kw. General Electric generator at 277 r.p.m., the engine being of the Alco-Sulzer 2-cycle marine type and bringing the present station rating to 3,525 kw. Preliminary tests indicate that a substantial gain in economy of operation will result from the acquisition of this fifth unit, with increased insurance against interruptions.

The fuel oil burned at Hudson is Navy "A" standard of the Cities Service Company, lubricating oil being supplied by the Texas Company. Cooling water for the engines is taken from the Assabet River, behind the plant, and for the five-year period the station has been served by two 20,000-gal. surface oil tanks, a New Jersey 10-ton traveling crane, two 6-in. Lawrence raw water pumps, two Lawrence jacket water pumps (5 in. and 4 in.), Maxim silencers, Bristol exhaust pyrometers, two De Laval centrifuges, a Worthington air compressor and Golden-Anderson emergency make-up valve. Each unit runs about 500 hours a month, and the practice is to maintain an average of 70 to 90 per cent rated load on each machine to insure maximum life and high efficiency.

The five-year operating table shows a marked and continuous rise in generated energy from 1932 on, a decided increase in yearly peaks and rather steady load factor. The generated output per gallon of fuel oil exceeds 12.5 kw.-hr., comparing favorably with the cost reports of the American Society of Mechanical Engineers on 160 Diesel installations in this country. It is noteworthy that while the total output has increased about 71 per cent since 1932, the total cost of operating the plant (excluding fixed charges) has risen only about 46 per cent. Fuel costs rose about 84 per cent total, and labor costs about 21 per cent during the period. While the cost of lubricants is not a large percentage of the operating total, it is interesting to note that these constitute a material ratio of the fuel cost. Maintenance of the internal combustion equipment trends upward from year to year, on the whole, but with the rigid schedules of inspection and repair provided the service record of the plant has been excellent.

The over-all cost of producing electricity in this plant, including the fixed charges per kilowatt-hour generated, can only be estimated from the balance sheet filed by the town department and published in its annual report. At the end of 1936, omitting cents, the generating station items listed in the assets totaled about $262,000, and if about half of the materials and supplies on hand are credited to the power plant, roughly $275,000 could be allocated to the station investment value. (These items included land, $500; structures, $62,843; fuel system, $5,044; internal combustion engines (four machines only), $141,922; auxiliaries, $14,982; electric plant (engine-driven) $28,186, and miscellaneous power plant equipment, $8,400. If 15 per cent total overhead is charged against this $275,000, the fixed charges then total $41,300. For a net production of 7,018,530 kw.-hr., the fixed charges per kilowatt-hour become just under 5.9 mills, bringing the estimated total cost for the year 1936 to 1.2 cents. If only 12 per cent overhead is figured the charges become $33,000, or, with the same net output as before, 4.7 mills, making the grand total virtually 1.19 cents.

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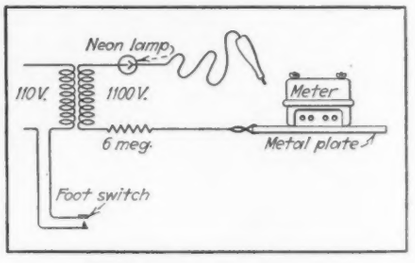
Insulation Test for Watt-hour Meters

For detecting grounds and for discovering incipient failures of insulation every meter that leaves the test boards of the meter department of the Union Electric Company of Missouri, St. Louis, is given a "high pot" check. This check is very quickly, safely and easily made with the simple apparatus which is illustrated in the accompanying diagram. The meter is just laid on the metal



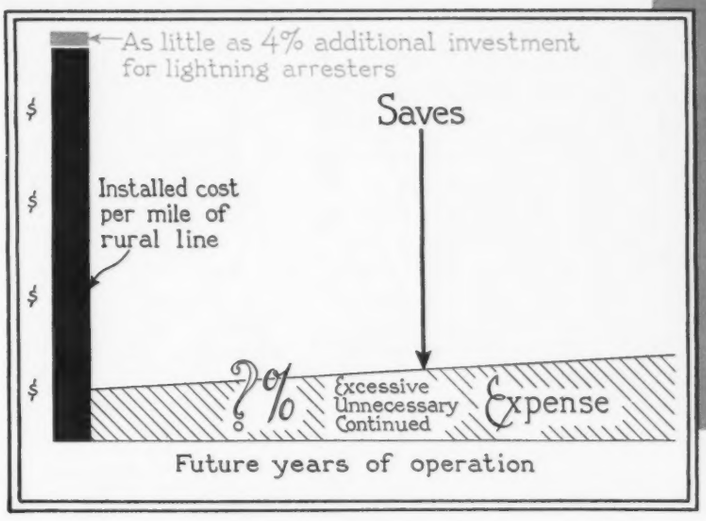
High pot meter test set

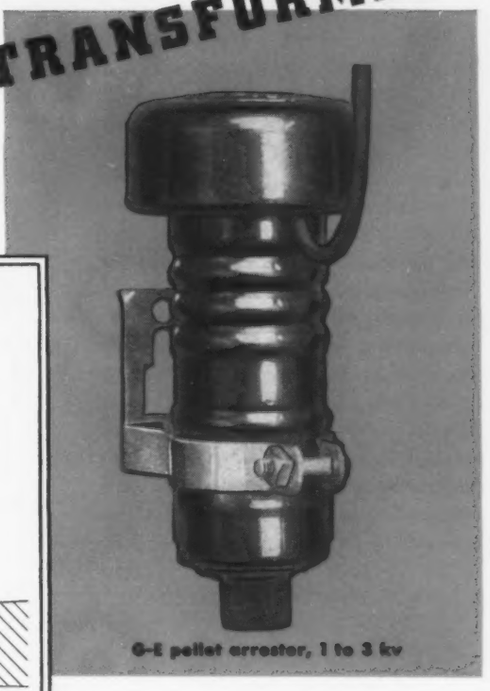
plate, the operator presses down on the foot contact and touches the test prod to the meter terminals. If the neon lamp glows brightly the insulation is weak or broken down and the meter is sent back for repair. Not many meters show failure under the test, but enough have done so to justify the check in preventing defective instruments from going out into service.

The neon lamp in series limits the amount of current that can flow in the test circuit and thus protects the operator. But the clearances in the lamp and socket are small and for this reason a six-megohm resistance is connected in the other high pot lead for double precaution. This resistance limits the current in the high-voltage circuit to less than 0.2 of a milliampere.

Why it pays

TO INSTALL PELLET ARRESTERS WITH EVERY RURAL TRANSFORMER




G-E pellet arrester, 1 to 3 kv

AN insignificant addition to your initial investment in a rural distribution system, spent for adequate lightning protection, may easily save you loss of revenue and maintenance and repair costs *many times exceeding* the cost of protection.

Lightning has proved to be the greatest source of operating troubles on rural distribution lines. G-E lightning arresters not only prevent these troubles—needless and growing expense in repairing and replacing equipment—but also assure the utmost in uninterrupted service and encourage the addition of new load. Furthermore, their valve action reduces the possibility of primary power voltage reaching the secondary circuit.

The value of installing arresters for lightning protection has been brought out repeatedly by published A.I.E.E. papers, in statements of this nature:

" . . . about 60 per cent reduction in transformer failures and even greater reduction in fuse blowings resulted when interconnection (of arresters) was introduced."

"Interconnection of the arrester ground with the secondary neutral has been found superior to other methods of protection."

" . . . in the field measurements . . . no recorded discharge resulted in failure of arrester or the protected transformer."

To gain the best lightning protection for your rural distribution lines and the greatest return on your investment, install G-E pellet-type arresters.

General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

330-263

Analyzer Locates Cable Fault Quickly

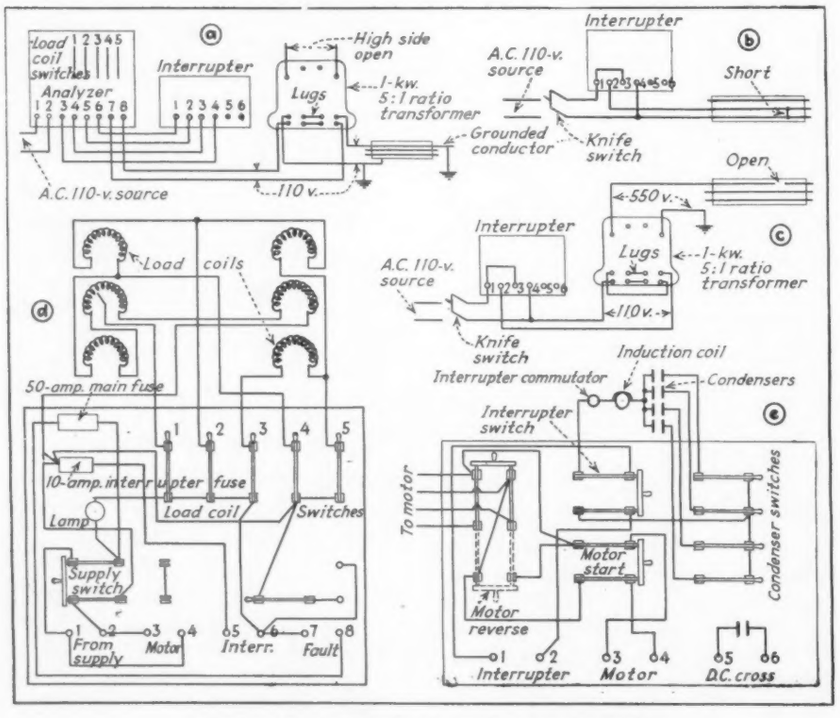
By GEORGE A. POSNER
Los Angeles, Calif.

Faults in underground transmission and distribution systems of a large California utility are now located at a considerable saving in labor and time by the use of a standard "Lundin" fault analyzer which assures location of cable troubles with a minimum of excavation.

After the occurrence of a fault the affected cable is de-energized. The faulty conductor and the type of fault (ground, short circuit or open circuit) is determined in the usual manner with a test lamp connected in one leg of 110-volt test leads.

With the faulty conductor located and the type of fault determined the analyzer is placed in the circuit with an interrupter as shown in the accompanying diagrams, the connections being made as illustrated according to the type of fault being located. A motor-driven commutator in circuit with variable capacity and inductance impresses a high-frequency, low-voltage potential on the conductor. This sets up a flow of current in the faulty conductor which can be easily detected by an operator walking parallel with the cable and carrying a detecting coil, amplifier and head phones. The signal in the phones reaches a maximum as the exact spot above the trouble is reached and diminishes as the operator walks away on either side. In a few instances a minimum signal occurs at the point of fault. The operator learns to recognize and distinguish these exceptions through experience. Detailed instructions for the operation of the Lundin analyzer follow:

With the interrupter and analyzer connected as in (a), (b) or (c), depending on whether the fault is a ground, short circuit or open circuit, the detecting unit, consisting of coil, amplifier and head phones, is brought into the manhole where the other equipment is. The operator lays the detector coil on the cable near the interrupter and adjusts the signal until distinct. Carrying the detecting unit, the operator proceeds to the midpoint of the line where he enters the manhole and listens to signals on both sides of the cable splice (there may be a failure in the splice). If the signal is still distinct he proceeds to the manhole nearest the midpoint of the remaining section of line. If the signal is still strong or stronger he repeats, eliminating half the remaining line at each step. If a distinct change is noticed in the signal or if the signal is lost the operator returns to a point half way between his present position and where he last heard the signal. When the faulty span is located, the operator enters manholes on each side of the span to verify.

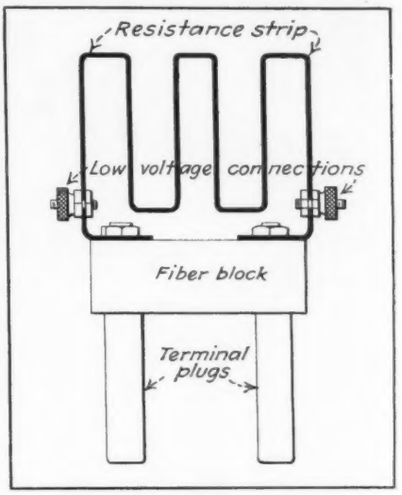


Analyzer detects faults in underground cables

(a) Connections for location of ground faults, (b) for location of short circuits, (c) for location of open circuits, (d) wiring diagram for analyzer, (e) wiring diagram for interrupter. Before connecting the interrupter to the 110-volt supply source as shown in the accompanying diagrams, the motor reverse switch, in (e), should be closed in either of its positions, and interrupter and motor start switches opened. Condenser switches are to be left closed at all times. To take equipment out of service open (1) interrupter switch (2) motor start switch, (3) double pole knife switch and (4) remove supply leads.

For Easier Control of Low-Test Voltages

Usual method for obtaining variable low voltage for testing in meter department and other electrical laboratories is by means of a slide wire potentiometer connected across the supply potential. For fairly low test pressures and using ordinary laboratory equipment, this method may have certain disadvantages by reason of difficulty in securing exact adjustments and in correcting for small momentary variations in the supply voltage. These disadvantages are minimized in the testing laboratory of the Milwaukee Electric Railway & Light Company by employing a simple device and circuit arrangeincluding a rheostat instead of a potentiometer.



Resistance strip and rheostat displace potentiometer

The device consists of a strip of resistance metal, mounted on a fiber body with a pair of terminal plugs, so spaced as to be pushed into the test board to make a connection in series with the control rheostat. The low-voltage connection is made on binding posts at the ends of the strip, as appears in the accompanying sketch. The rheostat varies the amount of current flowing through the resistance strip and thus the drop across it. As a means of control the rheostat is much easier to handle than would be the usual slide wire potentiometer and consequently the low-test voltage can be more easily set and held constant.

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Planned Promotion Sells Lighting

By G. V. GAYNOR
Illuminating Engineering Division, Commonwealth Edison Company

The Commonwealth Edison Company in Chicago is now making rapid strides modernizing the lighting system of its industrial customers, as the result of a planned promotional system, embodying two methods of approach: (1) Direct mail advertising stressing the advantages of proper illumination sent to plant managers and engineers. (2) A staff of lighting sales engineers regularly contacting each industrial plant.

The sales engineers are aided by illuminating engineers, who make lighting surveys, prescribe the remedial measures (which, in the case of illuminating engineering, may embrace mechanical and architectural changes as well as electrical ones) in co-operation with factory executives, and assist in making contact with contractors who are qualified to carry out the agreed plans.

An accurate lighting survey in the factory precedes every recommendation submitted. Plans are drawn of the work area involved, with building construction and ceiling heights carefully measured and any variance in floor levels noted. Machines and power drives are shown on the working print. In offices the location of desks and office equipment is of equivalent importance. The capacity and location of existing lighting equipment is designated.

To complete the survey, the engineer has to determine the difficulty of the seeing task in each location, including the degree of accuracy to which the product must conform and the extent to which this accuracy is dependent on the sight of the employes. The approximate age of the employe is often an important factor in this consideration, as speed and accuracy of vision are somewhat dependent on the age of the operators as well as the height of the working plane and the position of the worker relative to the machine.

The illuminating engineer then prepares his report, indicating the intensity of light required by, and the type of equipment most applicable to, the different tasks. His decisions are formulated from the field survey and his knowledge of the most modern lighting equipment available. The location of each fixture is shown on the print, with specifications on outlet capacity and fixture mounting height above the floor. Usually a recommendation as to the color of the paint for ceiling and side walls accompanies the layout. Provision is also made for flexibility of control and for future lighting requirements, so that reasonable provision is made to meet subsequent requirements through the installation of additional circuits or higher wattage lamps or both without revamping the entire installation. Finally, wiring specifications are checked to insure that the entire plan will conform to the electrical code.

Fixture costs and wiring estimates are then secured by the sales engineer and the completed lighting survey is submitted by him to the customer. It is usually advisable to make a small trial installation to furnish additional proof to the factory management that good lighting will pay dividends in dollars and cents. Many tests have shown that improved production and decreased

Eighth Appliance Sales Survey

ON PAGES 53 to 60 of this issue there is presented an editorial feature, the Eighth Appliance Sales Survey, probably of particular interest to readers of Building Up the Load. The Eighth Appliance Sales Survey is a summary of confidential reports of load building submitted by utility companies serving 14,000,000 to 15,000,000 residential customers.

Four solid pages of tables are used to present such figures as are of greatest interest at this time. Data presented by utility companies themselves permit an analysis of appliance sales by utilities and of sales by dealers and of the effects on customer use today.

Please turn to pages 53 to 60.

spoilage will more than offset the costs of a modern lighting system, while at the same time benefiting the workers.

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"Plan B" Starts in Nebraska Power Co.

"To consolidate the gains made by this contest, and to take advantage of the interest created in our territory, we are entering into Plan B, the General Electric Home Building Activity, as a strictly local contest," James E. Davidson, president of the Nebraska Power Company, states. "The company is offering $1,500 in prizes for homes built in our territory that most closely comply with the ten broad specifications for good home building."

A total of 34,354 Better Living Essays—one for every five booklets and entry blanks distributed—were secured by the employees of the Nebraska Power Company of Omaha, Council Bluffs and surrounding rural territory in Contest "A" of the Electrical Standard of Living activity co-sponsored by General Electric Company.

"We have presented this program (Plan B) to our employees and have found that some of them are seriously considering building or remodeling their homes," Mr. Davidson states. "They also have turned in names of people in this territory who are building or planning to build or remodel. Members of the local Builders Exchange, Real Estate Board, Electrical League and individual architects, builders and building supply trade also have been contacted for co-operation in stimulating interest in this contest.

"From this activity," Mr. Davidson said, "we anticipate an increase in the number of homes to be built and improved here in 1938, and also more adequate wiring of such homes for electrical outlets and appliances. This should lead to the sale of more electrical appliances."

At the helm, directing the contest, is a steering committee composed of representatives of architects, contractors, building supply dealers, realtors and the electrical industry. R. C. Geppert, general superintendent of the Nebraska Power Company, is chairman of the committee.

Prospects for entry in the contest are tabulated on cards in triplicate, listing all possible information about the home to be built or improved. One copy is filed for record to avoid duplication. A second is given to the wiring and kitchen-planning adviser, who makes the initial contact to offer the prospect his services and to urge him to enter the contest. The third copy is retained at contest headquarters to facilitate following it through for a contest entry. The company's salesmen and dealer-co-ordinator later receive the card from the kitchen planner, together with all information available in regard to the electrical appliances desired or needed.

Plans are being made to furnish programs featuring home building that accords with the ten specifications of Plan B, before luncheon clubs, better business bureaus, chambers of commerce and other civic groups.

•

Commercial Car Sells Equipment

By S. S. BRADFORD
Promotional Manager
Potomac Edison Company, Hagerstown, Md.

Previous years of experience in promoting the use of commercial pantry and counter equipment demonstrated the need for a display that could be carried to the commercial customer's premises, with facilities for demonstrating its operation. In September, 1937, a display car was put into service. A car was chosen rather than a trailer because of less seasonal interference with its use, easier parking and the limited number of persons in it at any particular time.

The equipment, mounted on specially built angle-iron counters, includes two fry kettles, two grills, three food warmers, waffle baker, toaster, coffee maker and ventilating fan with shutters.

The display is routed on a prearranged schedule to each of six men located in separate districts, for approximately three days in each three weeks. It is used in interesting new prospects and in closing those previously developed. Contact and closing activities continue between the periods the car is in use.

During the first 90 days 63 sales were made with a billing of $2,937 and 139.1 kw. was connected with an average estimated annual revenue of $3,894. We believe that the display was responsible for approximately 50 per cent of these sales. Numerous appliance sales were closed where we had been unable to secure action before. Also, orders were secured for items that we had never been able to sell from catalogs, etc.

To maintain interest, we plan to change the displays from time to time, and even to use the display car for other than cooking displays.

Results are judged by the general improvement in connected load, rather than by sales made directly from the car. The display car has increased both customer and commercial representative interest and has definitely stimulated the rate at which commercial cooking load is connected.

In 90 days commercial sales of Potomac Edison amounted to $2,900—New load was 139 kw., EAR $3,894

The FUSTAT
Stops needless blowing of fuses
Fits present fuseholders
The Fustat can be used in any Edison base fuseholder thru use of an adaptor that retails at 7½c.
Satisfied customers make YOU the most profit
. . . . and here's how the FUSTAT comes in!

Permits adding more appliances to present circuits

You can load an ordinary circuit right up to capacity and yet protect it with a 15 ampere Fustat. Its long time-lag keeps it from opening needlessly as when motors start on washing machines, oil burners, refrigerators and other appliances.

Thus you can expand the use of present circuits with perfect safety — and without incurring needless blowing of fuses.

Abolishes aggravating "blown-fuse" service calls

Such calls are wasteful and costly to everybody.

The user loses time and temper and often money when service is off.

The service man is dragged away from more profitable work.

Contractor or dealer loses if user kicks about paying full cost of a call where the only work done was to replace a blown fuse.

The Fustat stops such senseless waste because it doesn't blow needlessly.

Protects against dangerous overloading of circuits

The Fustat cannot be replaced with a penny or other substitute for the fuse — or with a size too large to protect.

The user is protected against anyone unwittingly creating a fire or personal injury risk thru haphazard practices that permit circuits to be overloaded. Once installed, SAFE protection REMAINS SAFE.

Nips out hazardous shorts in flexible cords

The Fustat contains a fuse. The ability of a fuse to protect against dangerous cord shorts, grounded sockets, etc., is well known.

Protective devices that do not open on short circuit as quickly as the Fustat permit the cord to burn out at the short. You get the fireworks in your face, or hands, or around the house where injury or damage may be caused or a fire started.

The quick action of the Fustat on short circuit prevents spraying of molten metal, burning of users, starting of fires.

Helps reduce user kicks about service or appliances

Users "just can't be made to understand" why other protective devices often open when there is nothing wrong.

When such needless shutdowns occur with newly purchased appliances they get particularly "hot" and generally throw the blame on whomever sold or installed the appliances.

Such user complaints hurt not only the dealer or contractor — but everybody in the Electrical Industry.

The Fustat offers a common sense way to reduce this evil to a minimum.

It's just good business to sell, install and use Fustats

The FUSTAT

Retails at 7½¢ in 15 to 30 amp. sizes

For full information write to any of these firms —

BUSSMANN MFG. CO., University at Jefferson, St. Louis, Mo.
JEFFERSON ELECTRIC CO., Bellwood, Ill.
KIRKMAN ENGINEERING CORP., 121 Sixth Ave., New York City
NATIONAL ELECTRIC PRODUCTS CORP., Fulton Bldg., Pittsburgh, Pa.
UNION INSULATING CO., 277 Broadway, New York City

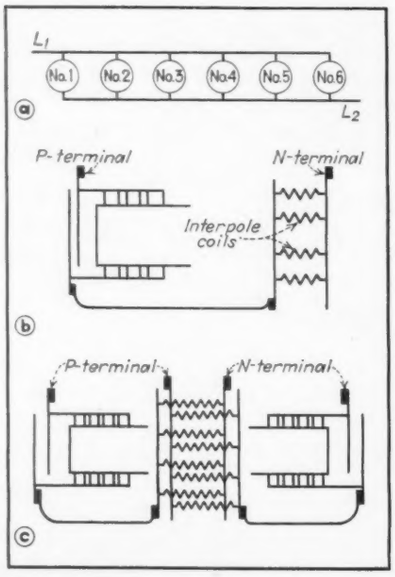
New ENGINEERING IDEAS

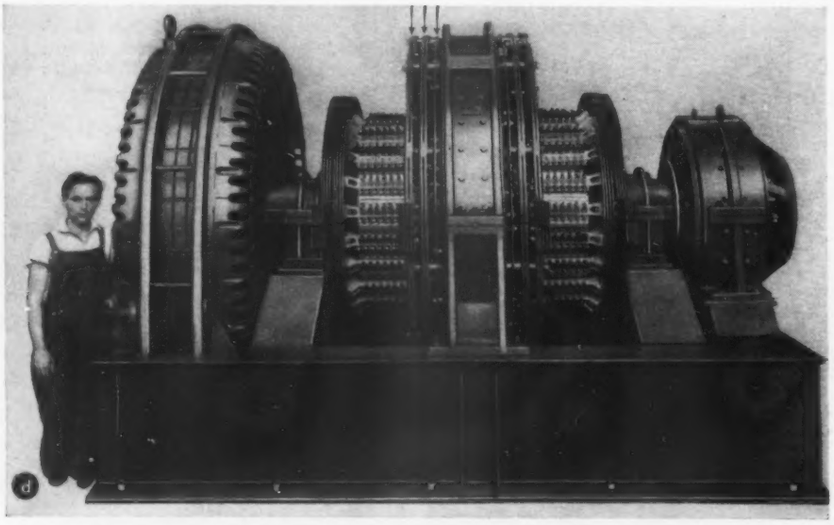
Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Use Balanced Circuit in Plating Generator

By CLARENCE E. BERGER
Electrical Engineer
Hanson-Van Winkle Munning Company,
Matawan, N. J.

Generators used in supplying electroplating current at low voltage and high amperage consist of many low-resistance circuits connected in parallel, in which it is important to have uniform current distribution. Uneven current distribution in the generator causes imperfect commutation and rapid and selective brush wear. The accompanying diagram shows schematically how uniform current distribution may be obtained in the case of single- and also double-commutator generators.





Balanced circuit design for electroplating generators insures equal current distribution and better commutation

Balanced circuit principle applied to lamps in parallel (a) results in uniform current distribution and improved commutation when applied to single (b) and double (c) commutator electroplating generators. (d) Double commutator low-voltage electroplating generator with balanced circuit. Rings indicated by arrows separate the interpole and series field windings so that independent adjustment of each winding can be made to get the maximum effect and sparkless commutation along with most exact voltage regulation.

In both cases the current-collecting devices (comprising brush-holders and brush rings) and the interpole circuit (comprising the interpole coils and their connecting bus) are balanced. Under these conditions the current distribution in the various circuits is most nearly perfect, with an equal distribution between all the brush-holder studs.

Paralleling and balancing of interpole circuits is the most important feature. In those cases in which the circuit from each brush-holder stud is conducted directly through an interpole opposite it, any tendency of one brush arm to take more than its share of the load strengthens the interpole affecting the armature coils connected to this brush-holder stud with a cumulative effect. This tends further to increase the unequal current distribution between brush studs, manifesting itself in the imperfect commutation and selective and rapid brush wear mentioned.

Just as it is possible to use a form of connection in the stationary current-carrying parts to effect an equal current distribution, there are forms of construction in the revolving armature which favor the equal distribution of current. These involve the use of balancing or equalizing coils in all commutators. These coils connect together all parts of the armature winding which are to be of the same potential. In the best armature construction each and every commutator bar is connected to all bars of the same potential, resulting in 100 per cent equalized armature construction with equal current distribution in all its circuits. There is therefore in the well-designed elec-

CURRENT DIVERSION MUST STOP!

FIGURES DON'T LIE!

Investigations usually disclose current diversion. Articles that have appeared in "Electrical World" show a tendency toward sizable magnitude of this practice unless it is checked.

To those who need to be convinced—to those who doubt the extent of tampering on their lines—we urge them to make a special analysis of a few hundred services.

A single case of tampering reported in the February 26th issue of "Electrical World" tells of a jail sentence for diverting $3200 of electrical energy.

Hundreds of utilities use the Murray Padlock Seal-ing system because they were wise enough to recognize the evil—and its antidote.

The tamperproof Murray Padlock Seal—sold only to utilities—provides safeguards that current thieves cannot surmount. Details will be gladly sent on request.

And if services need modernizing place your problem before us—our experience is extensive.

●

METROPOLITAN DEVICE CORP.
1250 Atlantic Ave. Brooklyn, N. Y.

A Lock Without a Key—It Snaps In Place

MURRAY PADLOCK SEAL

troplating generator balanced armature and brush circuits and balanced interpole and series field circuits.

•

Neon Light Displaces Incandescent Beacon

By C. H. LINDELL
Cincinnati Gas & Electric Company
Cincinnati, Ohio

Co-operating with the Department of Commerce for the protection of aviation, the Union Light, Heat & Power Company of Covington, Ky., has installed on one of its transmission towers located on the south side of the Ohio River a neon-induction obstruction light as a substitute for the usual incandescent beacon light. The tower supports the river span in the 66,000-volt line between Columbia generating system and West End generating station in Ohio. The light was imported from France by the American Gas Accumulator Company of Elizabeth, N. J., for experimental purposes and was installed with the permission of the Department of Commerce.

The light consists of two glass tubes 1.2 in. in diameter and 20 in. in length arranged in a straight unit with an insulating section between them. Inside of each tube is a helix of small glass tubing filled with neon gas, through which the discharge takes place. The center electrodes are connected directly to the 66,000-volt conductor and the end electrodes to aluminum disks mounted below and at the ends of the tubes. Current flows through the tubes from the center electrode to the aluminum disks, which provide a capacitance to ground. This discharge through the neon causes the tube to glow.

The reason for this installation is that no other source of energy is available at the tower site. It would have been necessary to erect a supply line approximately 3 miles long for the conventional type signals. Saving on the installation was estimated at $1,700.

In comparing the range of visibility of this light with that of the standard beacon it was found that at a distance of 1.4 miles the neon light faded from view, while the incandescent light could be seen from a distance of 2.5 miles.

•

Economical Size of Cable Conductor

By RAYMOND F. STAINBACK
University of North Carolina,
Chapel Hill

Derivation of a formula for determining the most economical size of conductor in underground cables buried in the ground hinges on the following expression for yearly cost of operation, c, in cents per year:

$$c = F(M + N + LO) + P + ZRI^2C_e/1{,}000$$

F = Fraction for depreciation, taxes and interest.
M = Labor costs of installation.
N = Cost of auxiliary parts.
L = Length of cable in feet.
O = Cost per foot of cable (includes conduit if used).
P = Annual maintenance costs.
Z = Number of conductors.
R = Resistance of each conductor.
I = Amperes per conductor.
t = Hours per year.
C_e = Cost of energy loss, cents per kw.-hr.

$R = 11.5L/A$, in which A is cross-sectional area in circular mils.

Cost per Foot of Four Makes of Three-Conductor Underground Cable

Size, No.	Area, Circ.mil.	Cost of 3-Conductor Cable — Cents per Foot A	B	C	D
0.....	105,535	145.2	123.0	97.2	79.0
00.....	133,077	164.8	149.3	111.0	92.6
000.....	167,806	184.4	167.8	132.4	106.6
0000....	211,600	203.3	186.4	148.0	125.4
	K_1	87.1	60.4	47.0	35.0
	K_2	0.00055	0.00059	0.00048	0.00043

A and B are for lead-covered and flat steel armored cable. C and D are non-metallic sheathed construction. All are three-conductor cables designed for burial directly in the ground.

$O = K_1 + AK_2$ in which K_1 depends largely on type of covering and overhead and labor not dependent on size of conductor and K_2 depends on conductor size.

In determining the values of K_1 and K_2 the values of A and the corresponding costs in cents per foot (O) from the accompanying table were put into the equation

$$O = K_1 + AK_2$$

for two different sizes of the same type and make of cable. The resulting two simultaneous equations were solved for the constants and these values entered on the table as given.

Since the area of conductor enters the yearly cost equation only through the cost of cable term $LAFK_2$ and the cost of the energy loss term. $11.5\ LZI^2tC_e/1{,}000A$, and since all other terms vanish when the cost equation is differentiated with respect to A, the equation may be simply stated without including any other terms:

$$c = LAFK_2 + 11.5\ LZI^2tC_e/1{,}000\ A.$$
$$dc/dA = LFK_2 - 11.5\ LZI^2tC_e/1{,}000A^2 = O \text{ for minimum cost.}$$

Solving this equation and simplifying, the following equation is obtained

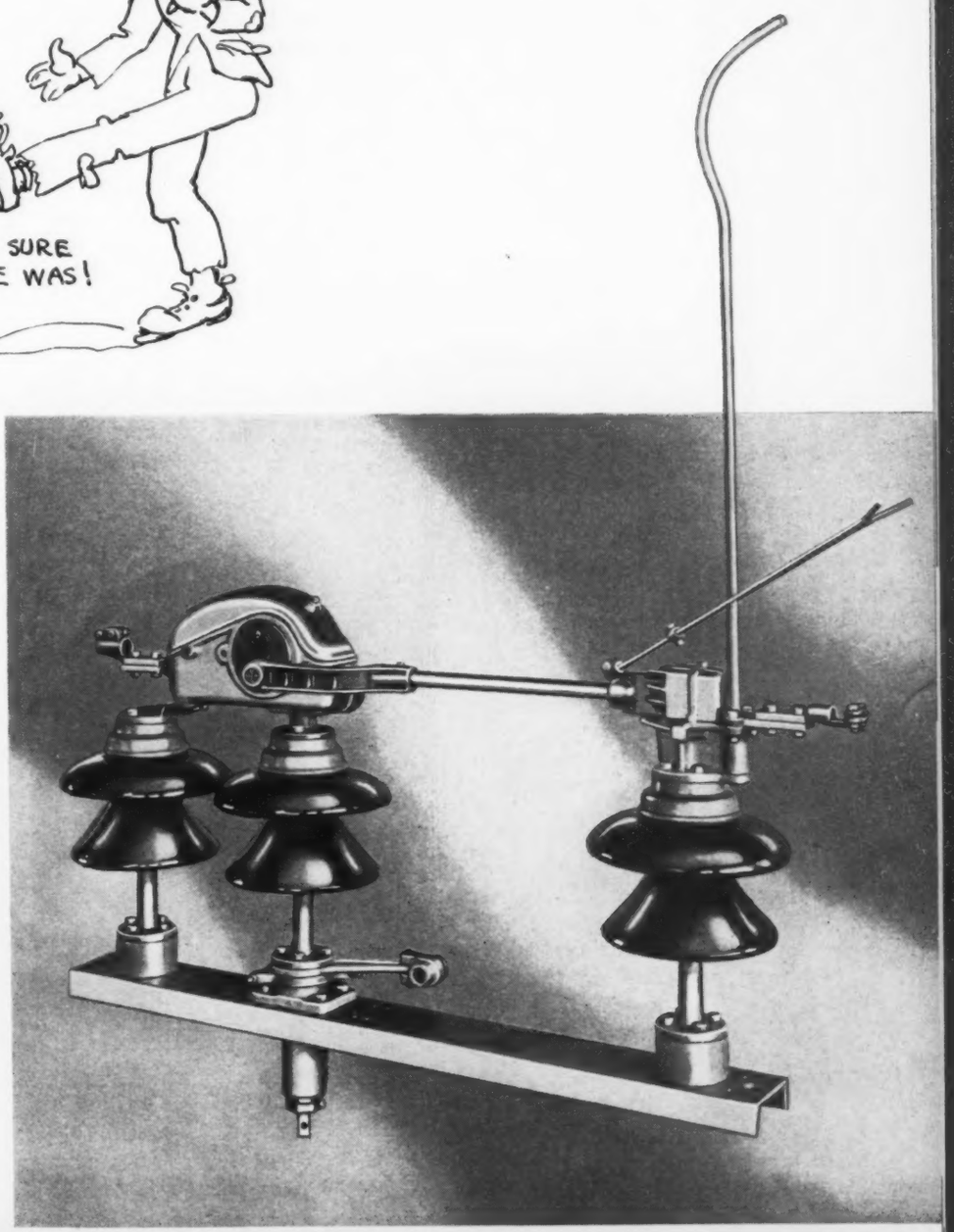
$$A = 16.85\ I\sqrt{\frac{C_e}{FK_2}}$$

for a three conductor cable in which K_2 is determined by simultaneous solution of the cost of cable equation using quoted prices in cents per foot on two different sizes of cable of the type to be used and for sizes not to far from the probably correct size. A good approximation of the most economical size may be obtained by using the average value of K_2 obtained from the table without securing other quotations. The equation thus simplified becomes

$$A\ 600\ I\sqrt{C_e/F}.$$

Neon aviation light for transmission tower

At 66,000-volt Ohio River crossing a capacitance-coupled beacon is hung on conductor on land side of tower, 135 ft. above ground



Among the many refinements in design which attest to Hi-Voltage's leadership in the field of Air Break Switch manufacture is the fully enclosed mechanism which alone can assure positive, easy operation under all weather conditions. Why not investigate Hi-Voltage's "pluses" in quality that ask no *premium* in price? Send for Bulletin 26 *today*, so you'll get the complete story and have specifications always available for ready reference.

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HI-VOLTAGE EQUIPMENT CO.

2891 EAST 79TH ST., CLEVELAND, OHIO

Industrial ELECTRIFICATION

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Suspended Cable Saves Money for Mine

Five hundred feet of 11-kv., suspension-type cable, installed vertically from the earth's surface into the mine, was the unusual means of saving $4,500 for the Lava Gold Mining Corporation recently when service was extended at its Central Mine near Nevada City, Cal.

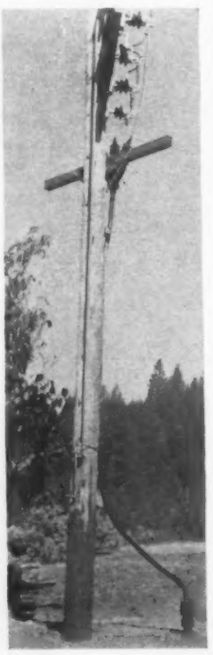
To connect its Central and Banner mines the company had run a 6,000 ft. tunnel from the surface. Within this tunnel was an underground substation housing three 11,000/440-volt, 150-kva. Pyranol transformers serving a 150-hp. hoist, a 250-hp. compressor and sundry small equipment.

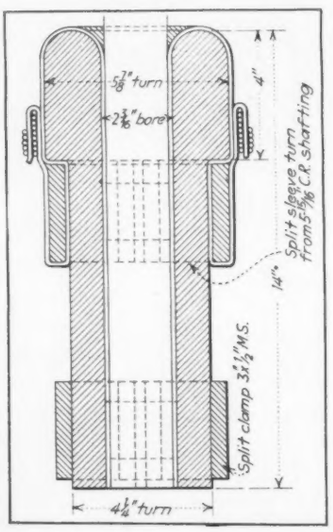
A power line on the surface followed the general direction of the tunnel. This suggested the possibility of furnishing power without running a line from the tunnel mouth. Hence a hole 485 ft. deep was drilled vertically from the surface to the tunnel. The first 96 ft. down to solid rock was cased with 3-in. pipe, cemented at the lower end to exclude water. Through the hole was dropped a 2 3/16-in. suspension-type, three-conductor, lead-covered, steel-armored cable.

To carry the weight of the cable an extra-heavy pipe clamp was fastened to the 3-in. pipe 4 ft. from the top. The ends of this clamp rested on two lengths of 60-lb. rail, which in turn were supported at each end by cement blocks cast in place.

A clamp, designed and made in the company shops, was seated squarely on the top end of the pipe and supported the weight of the cable by means of the wires composing the armor. These wires were cut and flared out around the body of the clamp, then back and forth under the outside clamps, which were securely bolted together. Enough cable was left above the support to run up a pole and terminate in an 11,000-volt pothead. The cable was rearmored where the wires had been removed in fastening the clamp.

Cost of supplying power to the mine in this manner was $2,571.14, of which $1,857.99 was for drilling the hole and sinking the pipe 34 ft. to bedrock. It is estimated that to carry cable 6,000 ft. through the tunnel would have cost about $7,000.





Point where suspension type cable leaves pole and enters 485-ft. drill hole to serve gold mine below. Detail of clamp devised to support vertical cable serving mine.

Reduce mine service cost by $4,500

•

Motor Stops Wrecks of Coal Monitor Cars

Elimination of wrecks and delays has in less than two years saved the cost of motorizing the incline used to lower coal from the dump house to the railroad tipple at the Bonny Blue Mine in Virginia. In addition, the motor, which acts as a generator most of the time that the incline is in operation, returns about 550 kw.-hr. to the mine power lines daily.

At this mine, operated by the Blue Diamond Coal Company, there is a difference in elevation of 950 ft. between the dumphouse and the tipple at the railroad tracks. To lower the coal an incline with two monitor cars in balance is used. The cars are connected by ropes which pass around a double pulley arrangement at the top of the incline, the loaded car descending the grade by gravity furnishing the power to pull the empty car up the grade. The average grade on the incline is close to 14 per cent, although it varies from a minimum of 6 per cent to a maximum of 27 per cent.

While the grade was steep enough to keep the loaded car moving at all times, the system would stall when the loaded car was on a part of the plane where the grade was slight and the empty car was on a steep part. To prevent such stalling it was necessary to run the cars at speeds as high as 3,000 ft. per minute. At this speed wrecks and delays were frequent and expensive.

To make possible a more nearly

NEW DESIGN *that provides great mechanical strength*

COMBINED WITH SUPERIOR ELECTRICAL PERFORMANCE

3 SIZES

TYPE 680—FOR VOLTAGES UP TO 15,000
TYPE 670—FOR VOLTAGES UP TO 10,000
TYPE 660—FOR VOLTAGES UP TO 8,000
Handle most PRIMARY line requirements

● Not only will the initial savings please you but their low-cost performance in the line will confirm your judgment in specifying the new series-600 Hemingrays.

Hemingray tougher glass insulators never age, are easy to inspect, and now provide greater leakage distance because of the new design.

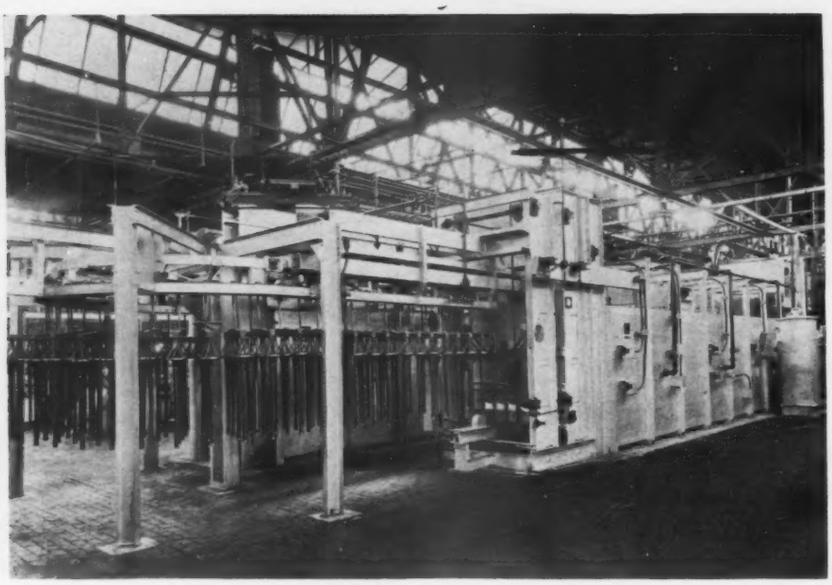
Manufacturing processes are more accurately controlled than ever before, resulting in uniform production and dependability in service under heavy loading or severe weather conditions.

Make that next order read "Hemingray series-600 Glass Insulators"—they are brass-bushed for greatest strength. Send for samples.

Owens-Illinois Glass Company, Hemingray Division, Muncie, Indiana.

FOR MODERN POWER LINE INSULATION

Order HEMINGRAY Glass INSULATORS



Harden, quench and draw 150 axles an hour in double furnace unit

Charging end of the scale-free hardening furnace in foreground. Conveying elevators carry axles through opening in bottom of gas hood, thence through furnace door into protective atmosphere of chamber. Quench tank and discharge end of equipment competely inclosed with baffles, except where conveying elevator lifts pieces from quench tank. Protective atmosphere equipment is at right.

constant speed and to provide a better means of controlling the cars a G.E. type MT motor, 600 hp., 2,200 volts, was connected to the pulley mechanism. When the loaded car is on the steeper parts of the profile the motor acts as a generator and furnishes regenerative braking. When the gravity force is not sufficient to keep the cars moving at a speed of about 1,750 ft. per minute the motor keeps up the speed.

When the motor is driving the cars it takes 300 hp. from the line and when acting as a regenerative brake it restores a peak of 1,200 hp. to the line. The motor is "plugged" to stop the cars at the end of the run. Either overspeed or voltage failure causes a solenoid valve to operate the air brakes and prevent the monitor cars from running away.

•

Double-Furnace Unit Treats Auto Axles

By W. F. ROSS
Electric Furnace Company,
Salem, Ohio

Rear axle shafts can be automatically scale-free hardened, quenched and drawn at the rate of 150 pieces per hour (2,250 net pounds) in a new double-furnace unit at the Pontiac Motor Company. Axles enter the hardening furnace through a sealed gas hood, four at a time on a fixture attached to a mechanical conveyor. The hood, acting as a gas bell, is open only at the bottom well below the furnace door. Rising within the hood, the conveyors pass the charge into the protective atmosphere of the furnace chamber through the furnace door.

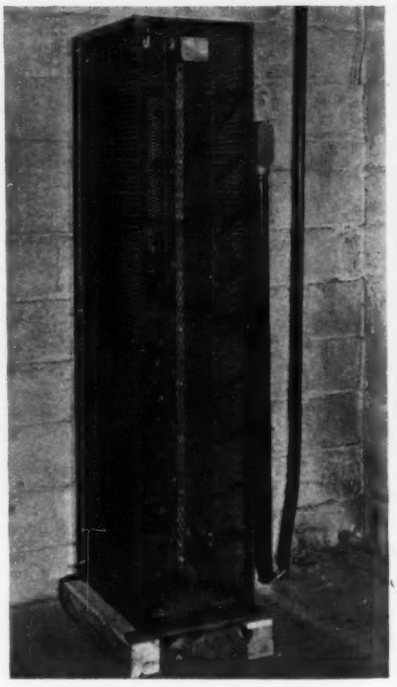
Axles move through the three zones of the hardening furnace at the rate of 28 ft. an hour. Temperature of the finished work is automatically controlled within a few degrees of 1,550 deg. F. Pieces discharged from the hardening furnace are dropped immediately into the water quench tank by the conveying mechanism. There the charge remains for 14½ minutes.

From the quench the axles pass to the draw furnace. Temperature within the four zones of this furnace is also automatically maintained at 750 deg. F. Since this is not sufficiently high to cause scale formation no protective atmosphere is used in the draw furnace.

The hardening furnace, which is rated at 450 kw.. and the draw furnace, which is rated at 250 kw., are each supplied through two air-cooled transformers connected to a 440-volt. three-phase supply. It is estimated that the two furnaces will use approximately 1,500,000 kw.-hr. per year. Heavy cast chrome nickel grids fastened to the furnace walls and floor are used in the heating zones. Each zone is equipped with thermocouples, heat fuse and individual pyrometer control units.

Hydraulically operated cylinders actuate reciprocating pawls to operate the conveyors that charge and discharge the furnace and pass the work through the heating chambers. The conveyors move 9 in. at a time at intervals of 1.6 minutes. The actuating cylinders are operated by a pump near a central control station and controlled by a number of reversing valves operated by cams upon the shaft of a motor gear reduction. Electrical equipment is provided for synchronizing the central control station with the circuits connecting protective limit switches throughout the mechanical system.

CAPACITATORS RETURN 38% OF COST IN YEAR



Typical of the savings that are being realized by the correction of power factor in industrial plants are the following data from a manufacturing plant making gas appliances, centrifugal blowers, etc., and operating 2,569 hours per year.

Monthly maximum 15-minute demand, 60 kw.

Annual power consumption, 115,000 kw.-hr.

Average power factor *before* correction, 67—70%.

Capacitors installed, 30 kva. in 45-kva. rack.

Average power factor *after* correction, 91 to 93%.

Annual savings returned 38.4% on investment.

—LEE C. SHELAIN, Central Illinois Electric & Gas Company, Rockford, Ill.

SHOW YOUR MEN the Brighter Side of Life!

Spread Pittsburgh Glorified Light Paints Throughout Your Factory

DON'T keep your men working in the dark! Paint bright, cheerful light throughout your plant with Pittsburgh Glorified Light systems. These scientifically prepared finishes will effectively increase illumination without adding one cent to electric bills. And better light, of course, means greater efficiency, fewer accidents, more work from your men—bigger profits in the end.

Pittsburgh's three Glorified Light systems have been perfected in our research laboratories with the aid of the world's leading experts on light control. These custom-made finishes are available for all types of factory lighting conditions.

Every foot-candle power of raw light, whether from natural or artificial sources, is converted into healthful, profitable illumination—illumination without the harmful glare that causes eye strain and fatigue.

Send for Valuable Book—FREE

Increase the production and efficiency of *your* plant. Send for the Pittsburgh "Glorified Light" book. In it you will find many interesting and valuable facts on proper lighting. Use the coupon below and get your free copy . . . . . Pittsburgh Plate Glass Company, Paint Division, Pittsburgh, Pa.

THERE IS A GLORIFIED LIGHT PRODUCT FOR EVERY TYPE OF FACTORY!

THE SNOLITE SYSTEM will bring profitable Glorified Light into any plant with normal interior surfaces:

THE SNOTEX SYSTEM is specially designed for all abnormal interior surfaces except those affected by fungus growth. It resists discoloration from humidity, fumes, gases and lack of daylight.

THE FUNGUSIDE SYSTEM effectually retards the growth of fungus. It is vitally necessary in bakeries and food factories —wherever fungus presents a serious problem.

Copr. 1938 Pittsburgh Plate Glass Co.

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COMPLETE LINE OF STRUCTURAL MAINTENANCE FINISHES

SEND FOR THIS BOOK TODAY

Pittsburgh Plate Glass Company
Paint Division, Dept. EW3,
Pittsburgh, Pennsylvania

Please send me free your book, "Glorified Light".

Name_____

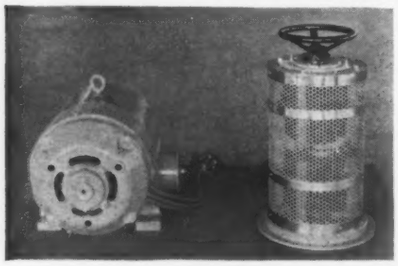
Address_____

City_____ State_____

New EQUIPMENT AVAILABLE

Polyphase Motor

Continuous speed adjustment from zero to about 50 per cent above synchronous speed is the feature of this new six-pole polyphase motor. Speed adjustment is provided through use of two single-phase



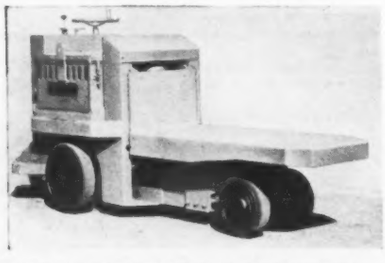
"Polyspeed," in 1, 2, 3, 4, 5 and 7½ hp. sizes for 220, 440 and 550-volt operation. All sizes 6-pole, top speed about 1,720 r.p.m. **Crocker-Wheeler Electric & Mfg. Co.,** Ampere, N. J.

induction regulators by means of which an adjustable polyphase voltage may be applied to brushes of motor commutator. Below synchronous speed this applied voltage bucks the voltage induced in the rotor by the rotating magnetic field and above synchronous speed it tends to increase this rotor voltage. Since an induction regulator is used, speed is adjusted without breaking motor circuit and without rheostat losses. Motor torque is said to be substantially constant over entire range. At speeds below synchronous slip energy is returned to the line through the regulator.

•

Electric Truck

New low-lift, elevating platform truck has a platform 27 in. wide and 66 in. long, lowering to 18 in. and raising to 24 in. Drive axle is of double reduction spiral bevel and spur gear type. Steering is of horizontally disposed wheel type, with Ross gear at base of vertical steering shaft. Snap-action contactor controller provides three travel speeds forward and reverse. Battery power assembly is in a demountable box compartment.

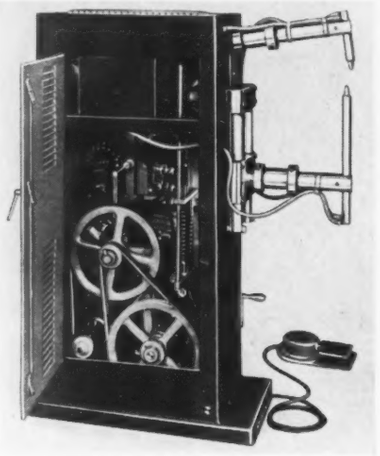


Model A-1020-28 low-lift, elevating platform truck; capacity, 6,000 lb. **Mercury Mfg. Co.,** Chicago, Ill.

•

Spot Welders

Increased output and decreased effort in control of their operation are said to be accomplished by new motor-driven automatic spot welders. Outstanding among their features are: "Reeves" vari-speed

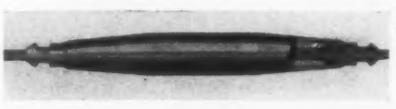


"ACE" motor-driven automatic spot welder; in four sizes, 15, 20, 30 and 50 kw. **Pier Equipment Mfg. Co.,** Benton Harbor, Mich.

transmission, giving a 3 to 1 speed variation and a mechanical weld timing control through which welding time may be set as fast as 1½ cycles or 1/40 second. Once set for a certain job, welding time and pressure are said to remain the same for each weld, an aid in quantity production. Movable foot switch controls the clutch operating power drive.

•

Line Splices

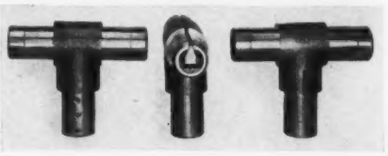


"Electroline" automatic line splice. **Electroline Co.,** Chicago, Ill.

New and practical features have been added to this company's line splices, which now are said to be fully reclaimable without tools and fully automatic. Gripping assemblies and the other automatic features of their original splice are retained, so that installed dependability and long life are assured, the company states. The one-piece streamlined housing inclosing the entire mechanism is also retained.

Bus Connector

Particularly adapted to application on high-capacity generator buses because of its ability to be completely covered with



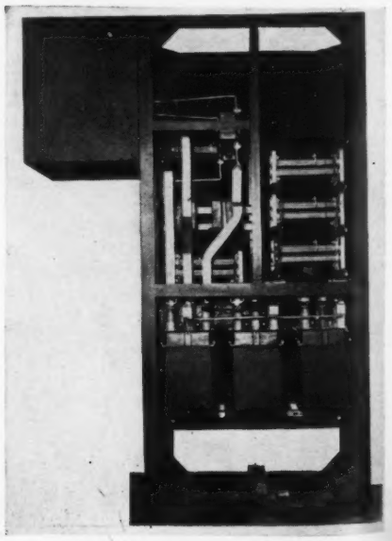
Internal expanding connector; in sizes to fit standard IPS copper tube; tees, elbows, lugs, butt joints among types offered; tee connector shown. **Memco Engineering & Mfg. Co.,** Long Island City, N. Y.

tubular insulation is a new internal expanding connector. Split sections of the copper-alloy connector fit inside the tubular bus to be joined, and, under the action of set-screw-driven wedges, expand to make firm contact with the inside of the bus. Since the shoulder on the connector is the same as the thickness of the tube being joined, the resulting joint is smooth.

•

Motor Control

New three-breaker combination containing forward, reverse and braking oil circuit breakers is a recent development for motor control. Each breaker is electrically operated with an independent solenoid



Motor starting and braking control; breakers are 25,000 kva. rupturing capacity, 7,500 volts, 600 amp. **Westinghouse Electric & Mfg. Co.,** East Pittsburgh, Pa.

On Guard

on all five continents!

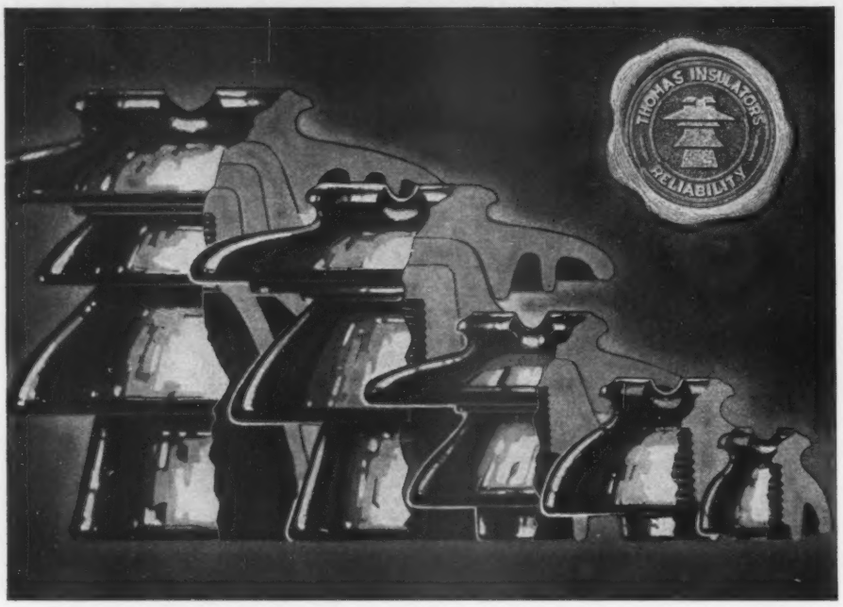
L-M LIGHTNING ARRESTERS

In Madras and Rio, Milwaukee and Sydney, utility men know from actual experience that when lightning hits you can depend on the protection of L-M Lightning Arresters. On all the earth's five continents the dependability of L-M Arresters is proved by their record on the line. » » Look through the transparent PYREX housing of an L-M Type "C" Arrester and you appreciate why this arrester has made a record of dependable, economical lightning protection. You'll see the rugged L-M Ladder Gap . . . designed to spark over the instant a surge occurs, and to take heavy surges without damage. You'll see the mass of Granulon Valve Material . . . insurance of high surge capacity and quick interruption of follow current. Because these features are plainly visible through the PYREX housing, L-M Arresters can be inspected accurately without disconnecting from the line. Double sealing at top and bottom keeps moisture out, lengthens service life. Ask your L-M representative for complete information. Line Material Co., South Milwaukee, Wis.

LM

LINE MATERIAL CO.

THOMAS INSULATORS



Catalog No. —	4040	3060	2124	1157	1009
Nominal Rating —	88Kv.	66Kv.	45Kv.	23Kv.	8Kv.

Thomas Pin Type Insulators are offered for all voltages up to and including 88 Kv. All are strictly modern in design yet embody certain definite and time-tried characteristics which insure maximum efficiency.

• **ROLLED EDGES** add to the general sturdiness and protect projecting flanges from mechanical injury. Thomas Insulators are seldom chipped or broken by linemen.

• **RUGGED LIPS** along the cemented sections add strength and prevent cracking at these points.

• **PORCELAIN SECTIONS** that guard the dielectric path and account for the dependable ruggedness of Thomas Insulators are of ample thickness to prevent shattering by the power arc. This porcelain mass also holds in case flanges are broken by missiles.

• **BINDING SURFACES** are treated where cemented by a resilient compound which prevents cracking due to expansion or contraction. Thomas Insulators have greater resistance to thermal shock, are not harmed by sudden extreme changes in temperature.

• **CABLE GROOVES** are well formed and spacious both for conductor and tie wire.

These and many other quality features combined with highest quality porcelain account for the Unexcelled Performance of Thomas Insulators. Install them today for dependable service.

"OUR 65th YEAR"

THE R. THOMAS & SONS COMPANY
ENGINEERS - MANUFACTURERS - DESIGNERS
LISBON, OHIO, U. S. A.
Established 1873
OFFICES - NEW YORK - BOSTON - CHICAGO
GRAYBAR ELECTRIC CO., INC., Agents
Incorporated 1892

mechanism. Forward and reverse breakers are arranged to close their contacts when solenoid is energized, while braking breaker contacts are opened when solenoid is energized. Brake contacts are spring closed when mechanism is tripped. All three breakers are both electrically and mechanically interlocked. Silver-to-silver contacts, "Deion" interrupters, Micarta bushings and inclosed construction are other features.

•

Street-Lighting Controller

Reliable operation of constant-current street-lighting circuits, plus lowered installation and maintenance costs, are stated as features of this new design of controller. Pole-type controller now has clamp bushings, with oil stops, as standard equip-

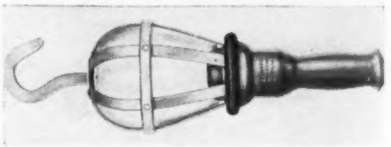
"Novalux" oil-immersed, street-lighting controller; types to operate normally open, normally closed or latched-in, in voltages up to 7,500. **General Electric Co.,** Schenectady, N. Y.

ment, to provide easier installation and removal. Two contacts of heavy, cadmium-plated copper are provided on each side of the line to assure a positive break and are located at the top of the unit, permitting replacement under oil without removal of the mechanism. Powerful solenoid unit is said to prevent possibility of contacts chattering. Manual operating lever is provided on both pole and subway types.

•

Trouble-Lamp Guards

A rubber locking ring is used on these screwless, shock-proof, portable lamp



"Safeguard" screwless, portable lamp guards; fiber or metal guards; 25 to 100 watts inclusive. **Safeguard Electric Co.,** 1 De Kalb Ave., Brooklyn, N. Y.

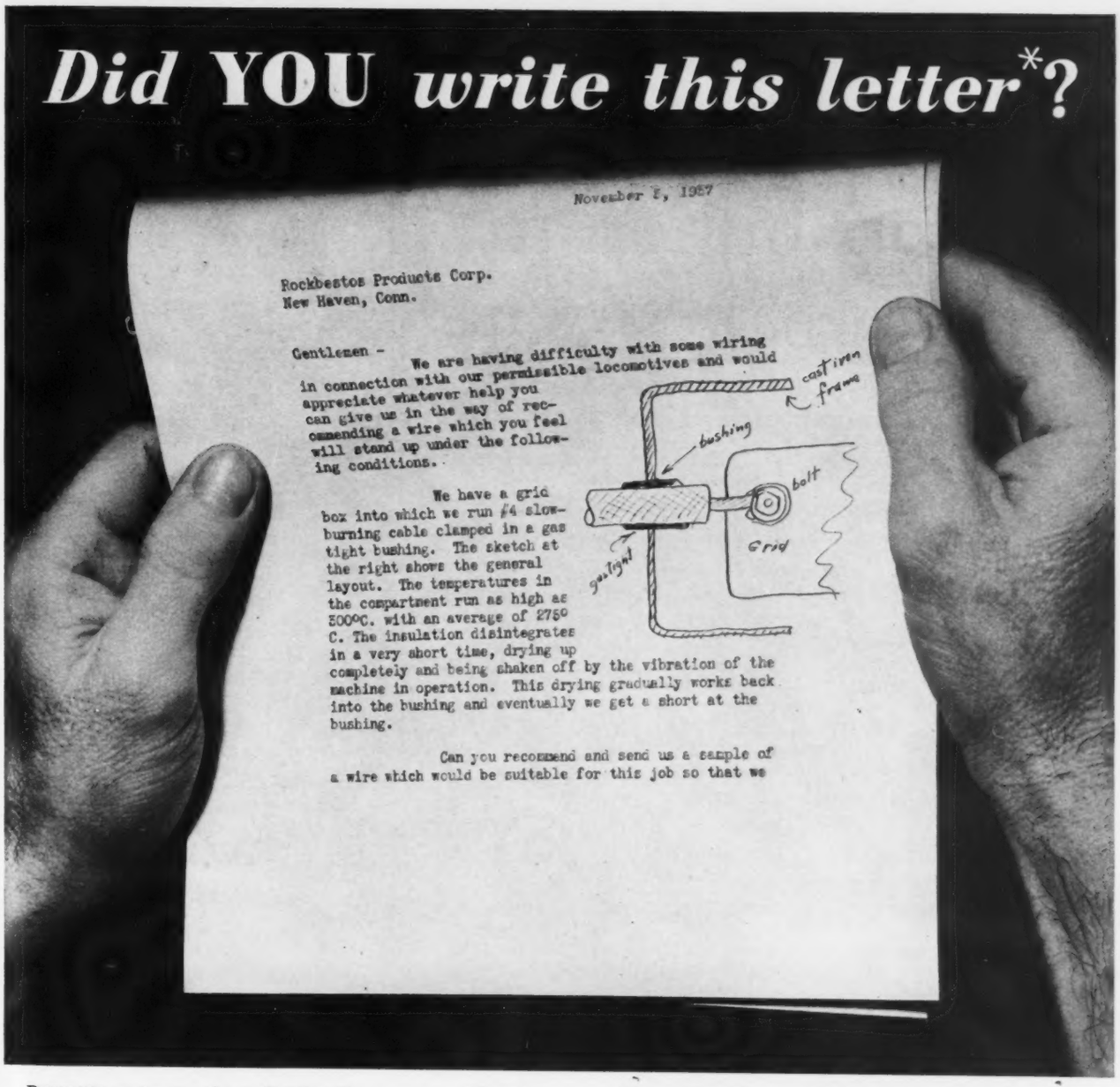
guards for holding the fiber or metal guard to the rubber handle. Rolling the ring back with the thumb permits easy removal of the cage for relamping.

•

Metal-Clad Switchgear

These new units, developed for heavy industrial or power house applications, are extensions of this company's vertical-lift, unit type, metal-inclosed switchgear. Units shown control and protect 2,000-amp. transformer circuits and a 600-amp. feeder. Special cable connecting compartments are built into the ends of the gear

Did YOU write this letter?*


November 5, 1937
Rockbestos Products Corp.
New Haven, Conn.
Gentlemen -
We are having difficulty with some wiring in connection with our permissible locomotives and would appreciate whatever help you can give us in the way of recommending a wire which you feel will stand up under the following conditions.
We have a grid box into which we run #4 slow-burning cable clamped in a gas tight bushing. The sketch at the right shows the general layout. The temperatures in the compartment run as high as 500°C. with an average of 275° C. The insulation disintegrates in a very short time, drying up completely and being shaken off by the vibration of the machine in operation. This drying gradually works back into the bushing and eventually we get a short at the bushing.
Can you recommend and send us a sample of a wire which would be suitable for this job so that we
cast iron frame
bushing
bolt
Grid
gas tight

PERHAPS you're not the author but if you were, we'd make the same attempt to be helpful that we made in this instance. Read the letter above, then read the reply sent by our Engineering Department along with a length of trial cable.

"Initially the wire breaks down at approximately 4000 volts. After heating in an oven at 400° F. for 48 hours, the breakdown was 5000 volts. For all testing the conductor was wound spirally with a small wire to act as a metallic cover or contact with conduit. Another sample was placed in an oven, energized at 220 volts a.c., raised to a temperature of 700° F. and held for approximately 30 minutes with no sign of breakdown or leakage current. The same sample was then placed in a 100% humidity chamber for 24 hours and was again placed in the oven, energized at 220 volts and raised to 700° F. without failure. It was then placed in the 100% humidity chamber for 4 hours, then energized at 440 volts a.c. without sign of leakage current. While the sample was still damp it was tested for breakdown and punctured at 4200 volts. On two successive tests on the same sample it broke down at 3200 volts and 3000 volts, all failures occurring at the same hole showing there was no carbonization at the point of fault. The sample was then dipped in water until it was saturated and then was energized at 200 volts a.c. through a 6 ampere fuse. The water immediately steamed off with no failure of the insulation and without blowing the fuse.

"We feel that the above tests are more severe than those under which the wire would normally operate and if this type of wire is used for your application its life should be far greater than that which it is to replace."

If you have any problem where wire is being attacked by heat, fumes, grease or where fire hazards exist, dump it in our laps. We'll analyze, send a sample of one of our standard wires if we think it will do the trick, or do our best to make up a special sample for you, as in this case. We want you for a customer and are willing to work to get you. How about writing?

ROCKBESTOS PRODUCTS CORPORATION
880 Nicoll Street, New Haven, Conn.

**Based on an actual inquiry and subsequent correspondence.*

ROCKBESTOS—*the wire with permanent insulation*

Another

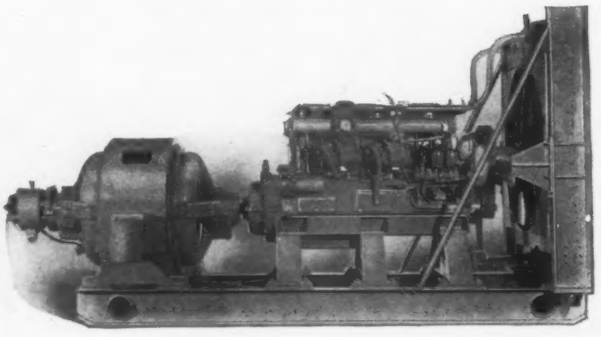
Contribution to PROGRESS!!

HIGH POWERED PORTABLE
EMERGENCY GENERATOR SET

STERLING HIGH DUTY

Sterling
THE ENGINE OF REFINEMENT

INTERNAL COMBUSTION ENGINES



150 Kilowatt, 1800 R.P.M. Emergency Generator Set. Sterling Dolphin 6-cylinder, 240 H.P. engine, direct connected to General Electric Generator, for portable emergency work. Built for Philadelphia Electric Company. Weight—11,160 pounds, as illustrated. Close governor regulation.

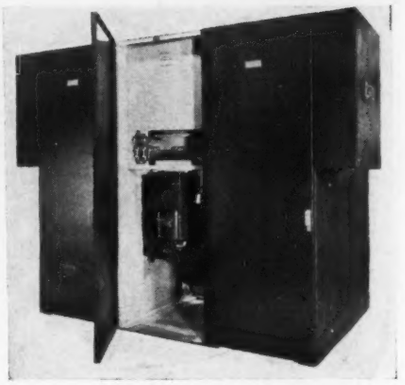
Built on an unweaving foundation, for mounting on a truck. Can be used also for stationary work. Utilities, telephone, and electric companies, can now provide continuity of service at the least possible cost.

STERLING ENGINE COMPANY

Home Office and Plant,
1270 Niagara Street,
Buffalo, New York

Dept. C-2

Branch Office,
900 Chrysler Bldg.
New York, N. Y



Unit type "RI"; 15 kv., 2,000 amp., 500,000 kva. **Delta-Star Electric Co.,** Chicago, Ill.

to accommodate temporary cable taps from the main bus. Future units may be added to either end.

•

Fiber Conduit

High strength, permanence, protection of cable against soil corrosion and electrolysis and decreased material and installation costs are the outstanding features claimed for this new conduit. Designed

Orangeburg "Nocrete" conduit; complete line of fittings for conduit also offered. **Fibre Conduit Co.,** New York, N. Y.

for underground use without concrete encasement, it is suggested for use for house connections, laterals (one-, two- and three-duct runs), street and parkway lighting and other applications where iron pipe has been customary. Crushing strength of the conduit is said to be more than double the crushing strength standards established for soil tile and greater than usual culvert requirements.

•

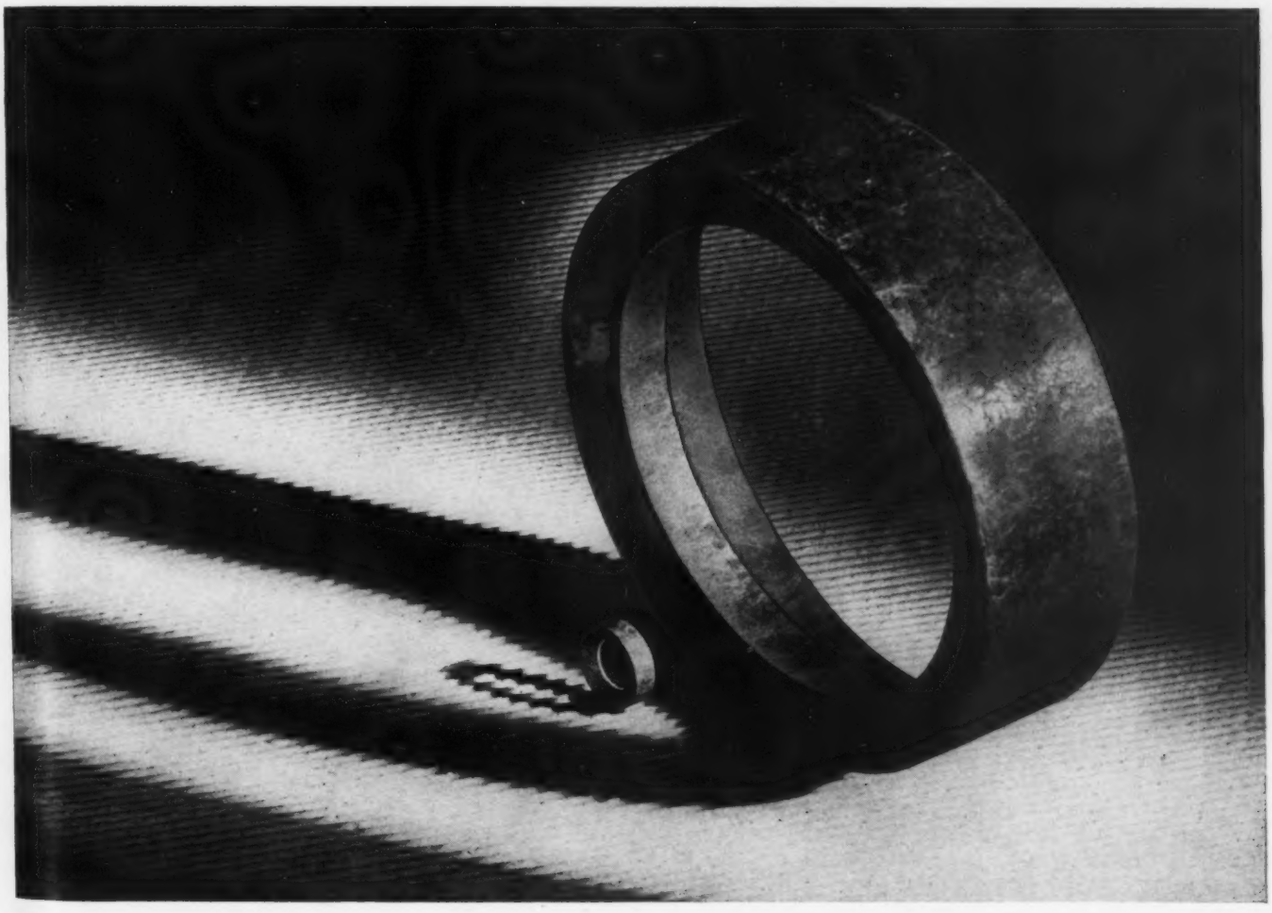
Voltage Attachment

A voltage attachment for use with this company's "Tong Test" ammeters is a re-

"Voltor" in use with company's "Tong Test" ammeter; for use with 50-amp. element of type A or AX, or 75-amp. element of type B or C "Tong Test." **Columbia Electric Mfg. Co.,** Cleveland, Ohio.

MACALLEN MICA
to Specification

In engineering design, the essential worth of any part or ingredient is measured by its unfailing resistance to impairment or destruction. Industrial insulation demands an element of superior dielectric qualities—and beyond that, a stamina that continuously resists such common enemies as heat, moisture and friction. Macallen Mica—refined in the volcanic crucible of the world's creation—challenges substitution in its versatile and durable worth. Macallen



processing builds, cuts and forms mica, without sacrifice of its effectiveness, into thousands of useful forms. Consult our engineering department on your requirements.

THE MACALLEN COMPANY
16 MACALLEN STREET, BOSTON, MASS.
Chicago: 585 W. Washington Blvd. **Cleveland: 902 Leader Bldg.**

COMPRESSED SHEET • MICA PAPER, CLOTH, TAPE • HEATER PLATE • COMPRESSED SHEET TUBING • COMMUTATOR INSULATION • COMPRESSED SHEET WASHERS • INSULATING JOINTS AND CANOPY INSULATORS • RAILWAY SPECIALTIES • DOMESTIC AND IMPORTED RAW MICA

"Give us Colortops!"

Central Stations say:—

"Give us Colortops for easy selection, quick inspection, safe shock and vent-proof top and absolute dependability."

Dealers say:—

"Give us Colortops! Customers want an all-porcelain shock and vent-proof fuse. Also, the riot of colors attracts the trade and doubles our electrical counter sales."

Contractors say:—

"Give us Colortops! They put that vital touch of quality on that finished job."

Wholesalers say:—

"Give us Colortops! They're chuck full of "Plus Values" and stay sold."

You can't go wrong with

COLORTOPS

America's Aristocrat of Plug Fuses

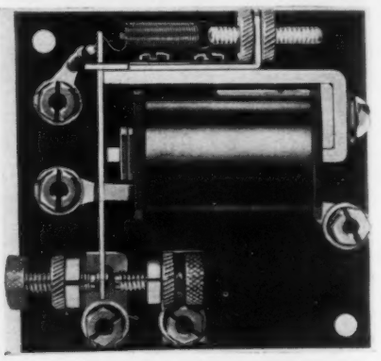
TRICO TRICO FUSE MFG. CO. FUSES
Milwaukee Wisconsin

cent development and is designed to measure both a.c. and d.c. voltages up to 600. To use the attachment the operator connects the two leads to the line as he would the ordinary voltmeter. Tongs of the ammeter are closed about the opening in the device and the reading of the ammeter converted to volts by referring to a chart on side of the voltage attachment. Rotary switch on the unit provides three voltage ranges.

•

A. C. Relay

Use of nickel alloy in the magnetic circuit of this new a.c. relay is said to provide a high degree of sensitivity, good



A.c. relay; coils available for currents from 1.5 to 450 milliamp. **Ward Leonard Electric Co.,** Mount Vernon, N. Y.

contact torque at pull-up and a crisp, constant drop-out. Available with single-pole, double-throw contacts, the relay may be mounted in any position without altering its performance, according to the company.

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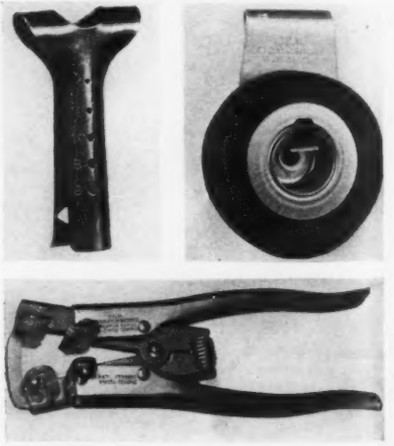
Electrician's Tools

Three new tools recently added to this company's line include a cable ripper, suggested for particular use on non-metallic sheathed duplex or lead-covered cables; a friction and rubber tape holder, which



Cable ripper, top, left; tape holder, top, right; automatic wire stripper, bottom, in sizes to handle wire from 10 to 30 gauge. **Ideal Commutator Dresser Co.,** Sycamore, Ill.

is worn on the belt and tape rolled off as it is needed, and an automatic wire stripper, which operates much like a pair of pliers and has a lever which stops the return of the arms until wire is removed after stripping and is then snapped back to normal. Automatic stripper is particularly designed for stripping stranded wires and is said to prevent jamming of strands.

EXTRA CHARGE FOR THIS FEATURE • IT'S STANDARD ON ALLIS-CHALMERS POWER TRANSFORMERS

U REDUCE OPERATING COSTS WITH THE LLIS-CHALMERS NO-LOAD TAP CHANGER

If you are looking for more efficient, safer, and money-ving transformer operation, you can get them with lis-Chalmers Power Transformers that come equipped h Allis-Chalmers No-Load Tap Changers at no extra st • The reason? It's the distinctly different design d construction of the Allis-Chalmers No-Load Tap anger which places it on the side of the transformer e with every tap position clearly visible from the ound • That means your operators don't have to nd unnecessary time climbing to the top of the trans-mer tank every time they want to observe or change tap setting • And what's more, it's positive protec-n against the danger of ever coming in contact with high voltage overhead system, which is a constant ard with tap changers that are on the cover of the nsformer • Other factors that make the Allis-Chalmers -Load Tap Changer the most efficient on the market ay are: A stuffing box that may be tightened as de-d without removing the transformer from service • p changer insulating surfaces mounted in a vertical ne • Heavy contact pressure • Large liberal dimen-ns and a scrubbing action with the contacts • With ee-phase transformers all phases operated together m the single handle, eliminating any chance of one se being different from the others • Other exclusive lis-Chalmers features are: Unusual Core and Coil As-mblies, the Uni-directional Breather, Oil-Sealed Inert-s System, Oil-Tite Construction, Combined Expansion nk and Relief Device, and Tap Changing Under Load ith unusual conveniences • Make your dollar go rther — specify Allis-Chalmers Power Transformers.

855

TRANSFORMER DIVISION
ALLIS-CHALMERS
MILWAUKEE·WISCONSIN

News ABOUT PEOPLE

Two Frigidaire Executives Receive New Assignments

Two promotions within the headquarters staff of Frigidaire division, General Motors Corporation, has been announced. Edgar A. Fisher, manager of the appliance engineering department, has been appointed general budget director of Frigidaire division. F. H. McCormick, chief engineer, electric range engineering department, has been appointed manager of the appliance engineering department.

In his new position Mr. Fisher will be in active charge of expense control for all Frigidaire departments. He has been with Frigidaire and its predecessor companies for 22 years.

Mr. McCormick is widely known in the electrical industry. Before joining Frigidaire several years ago, he was assistant chief engineer of Edison General Electric Appliance Company, having started his manufacturing career with General Electric at Pittsfield,

F. H. McCormick

Mass. His first connection, following graduation from Washington State College, was with the Washington Water Power Company. As a utility man he sold and serviced some of the first electric ranges built. As engineer and assistant chief engineer for Edison General Electric Appliance Mr. McCormick had direct charge of design of all Hotpoint and General Electric ranges and water heaters from 1922 to 1935, when he moved to Dayton.

•

Wisconsin Utility Makes Changes in Officers' Staff

Several changes in officers of Wisconsin Public Service Corporation were voted at the recent meeting of the board of directors.

C. E. Kohlhepp, vice-president and treasurer, was elected vice-president and controller; D. W. Faber, formerly assistant secretary and assistant treasurer, was elected secretary; H. P. Taylor, formerly assistant secretary and assistant treasurer, was elected treasurer; I. P. Steybe was elected assistant secretary, and A. E. Granholm was elected assistant treasurer.

At a meeting of the board of directors of Menominee and Marinette Light & Traction Company, subsidiary of Wisconsin Public Service Corporation, A. G. Carson and A. J. Goedjen were elected directors and Mr. Goedjen was elected vice-president of the company. Other changes in the officers of Menominee and Marinette Light & Traction, similar to those outlined above for Wisconsin Public Service Corporation, were also made.

•

▶ JAMES C. BONBRIGHT of New York City has been nominated by Governor Lehman for reappointment as trustee of the Power Authority of the State of New York and the Senate has confirmed the nomination.

▶ A. E. FLEMING of the commercial lighting sales staff, Utah Power & Light Company, has resigned to become lighting specialist for the General Electric Supply Corporation with headquarters in Denver, Colo. Mr. Fleming has been secretary-treasurer of the Utah Chapter, Northwestern Section, International Association of Electrical Inspectors in Salt Lake City.

Leon A. Watts Promoted by Allis-Chalmers Company

Leon A. Watts has been appointed to succeed the late Samuel Moore as general superintendent of Allis-Chalmers Manufacturing Company's service and erecting department. Mr. Watts joined the company in 1903 and during his

many years of shop and field service experience has handled practically every line of Allis-Chalmers equipment, including many of the larger steam and hydro-electric power units, cement mill equipment, mining and electrical machinery. In 1925 he was stationed at Atlanta, Ga., after having been appointed district superintendent of service and erection for the southeastern section of the United States. In 1935 he was transferred to Milwaukee as assistant to Mr. Moore, whom he now succeeds.

In the course of his career Mr. Watts has supervised the erecting of some of the largest hydro-electric plants in the United States and Japan. Various phases of his work have taken him to every state of the Union and to many foreign countries.

•

▶ CHESTER DALE has resigned as a director and member of the executive committee of the American Water

FOR USE UNDERGROUND WITHOUT CONCRETE ENCASEMENT

Orangeburg now offers a new non-metallic conduit combining the various characteristics required for use underground without concrete encasement; house connections, laterals and extensions, single, double and even triple duct runs; parkway, lighting and suburban services; signal systems; substation yards and industrial or institution grounds.

Strength

• New equipment and improved process enable a heavier, dense, homogeneous wall of greater strength fibre conduit than ever before produced, combining crushing strength in excess of soil tile and usual culvert requirements with toughness and high tensile and "beam" strength to withstand soil stresses.

Permanence

• Orangeburg NOCRETE Conduit, essentially a tube of everlasting coal tar pitch, reinforced with felted fibres, is immune to the corrosive elements encountered in the soil. Termites or tree roots will not enter or affect Orangeburg NOCRETE Conduit.

Cable protection

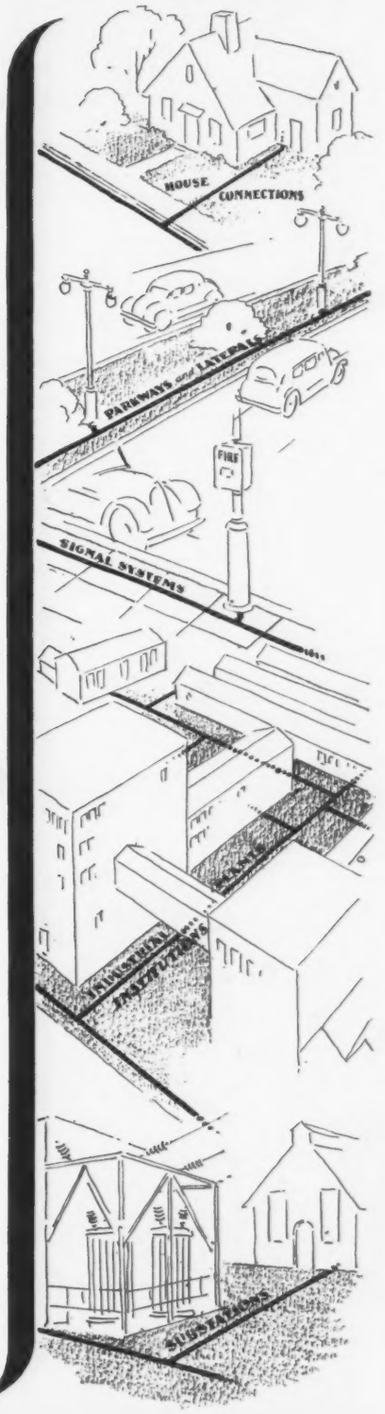
• Orangeburg NOCRETE is chemically inert and neutral with all the values of permanent cable protection which have characterized "Orangeburg" for 45 years.

It is smooth of bore, of frictional and abrasive minima, non-permeable to relatively high hydrostatic pressures; with water-tight Harrington joints, high resistance to electric currents, it provides real protection against electrolysis and other damage to cable sheath.

Dual economy

• Orangeburg NOCRETE Conduit offers substantial savings in both initial material and installation costs. Priced at about half the cost of metal pipe it will be found lower in *ultimate* cost than, even, cable buried directly in the ground.

Installation costs of this super-sturdy duct will reflect the easier handling, easier cutting and tooling, adaptability to going around curves and obstructions and quick field assembly.



NOCRETE CONDUIT

THE FIBRE CONDUIT COMPANY • ORANGEBURG N.Y. • *Sales Office* 292 MADISON AVE. N.Y.C.
GENERAL ELECTRIC SUPPLY CORP. • • *Sales Agents* • • GRAYBAR ELECTRIC CO. INC.

"KIDNAPPED KURRENT"

(polyphase style)

Each case of polyphase current diversion is expensive. If polyphase diversion was as prevalent as single phase — oh my!

Those big revenue polyphase meters of yours, ALL OF THEM, deserve proper protection from dirt, deviltry and diversion.

Superior polyphase Overall Meter Enclosures will protect those meters.

Write for Bulletin No. 379

Superior Switchboard & Devices Company

CANTON, OHIO

*Been at it Since 1920

SUPERIOR

REG. U. S. PAT. OFF.

Works & Electric Company, its subsidiaries and affiliated companies, according to an announcement made by H. Hobart Porter, chairman of the company.

▶ DOZIER A. DEVANE, solicitor for the Federal Power Commission and chief of its division of costs, valuations and accounts, has resigned to become associated in a private law practice with Charles O. Andrews, Jr., son of the Senator from Florida. Mr. DeVane assisted in drafting the federal power act of 1935 (Title II of the utility holding company act) and also served as legal adviser in drafting the pending Lea bill for the federal regulation of natural gas. Before entering the government service four years ago he was chief counsel for the Chesapeake & Potomac Telephone Company.

▶ ROBERT PROTHEROE, chief electrician of the Washington Gas & Electric Company at Longview, has been made manager of the Longview division of the company, to succeed Ralph T. Smalley now connected with the Arizona Edison Company. Mr. Protheroe had been chief electrician at the Longview Steam plant from the time this plant was put into service by Longbell Lumber Company in 1924. When the Washington Gas & Electric Company purchased the plant in 1930, he was retained in that position. He is a graduate of Columbia University and gained his early experience in the electrical industry in the underground sub-station department of Commonwealth Edison Company, Chicago.

▶ KENNETH S. WYATT, who engaged in research on high-voltage insulation for the Detroit Edison Company for nine years, has resigned to become technical director of the Enfield Cable Works, Ltd., at Enfield, London, England. In his new work Mr. Wyatt will have charge of manufacturing and installation, but he will devote his time particularly to research on new types of cables, with special attention to extra-high-voltage underground cable and to new materials which enter into the installation of all wires and cables down to the lowest voltages. Mr. Wyatt has participated actively in the committee work of various engineering societies. He is chairman of the Committee on Insulating Oils of the Utilities Co-ordinated Research; chairman of the subcommittee on chemistry of the electrical insulation committee of the National Research Council; a member of the high-tension cable committee and other committees of the Association of Edison Illuminating Companies and of the research committee and of the Edison gold medal committee of the American Institute of Electrical

Protect the Load with

BERMICO DURA-CELL CONDUIT

WITH today's heavy loads, continuity of service depends upon adequate cable protection. Bermico Dura-Cell—the only conduit made stronger, tougher and more permanent with virgin wood fibre—has "what it takes" for this all important task.

Rapid heat dissipation . . . high resistance to shocks and impacts . . . immunity to attacks of insect pests, alkalies, acids, corrosion, electrolysis and similar destructive agents . . . Bermico Dura-Cell gives you these essential protective qualities because it is made of tougher, stronger fibre—virgin wood fibre, specially selected and processed for conduit use.

Additional money saving Bermico Dura-Cell features are:

1. A non-split coupling (in 3" to 5" sizes) speeds installation and cuts labor costs.
2. Lighter weight reduces trucking and handling expense.

Write for Bermico Catalog. Brown Company, 420 Lexington Avenue, New York City.

WHY THIS NEW COUPLING CAN'T SPLIT

Driving forces tapered conduit ends solidly against fillet in center of coupling. Pressure is held on direct line through fillet. Ends cannot wedge and press outward to split the coupling.

EXCLUSIVE DISTRIBUTORS
WESTINGHOUSE ELECTRIC SUPPLY COMPANY
BRANCHES IN EVERY LARGE CITY

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FOREMOST PRODUCERS OF PURIFIED CELLULOSES FOR QUALITY PRODUCTS

VIRGIN WOOD FIBRE GIVES GREATER STRENGTH TO BERMICO DURA-CELL

INSULATION HEADQUARTERS

Is the performance of your product up to the standards you originally set? Would an improvement in appearance affect its sales? Are your competitors underquoting you? Often those are the questions behind the mystery of your own personal "business recession." And often Continental-Diamond's Engineers can clear up that mystery through intelligent research and experiment. Because these engineers are versed in a wide range of materials their advice is unbiased and their opinion valued. Avail yourself of this service now and let's see if we can't help you step up sales and increase net profits. A letter from you will make the next move ours.

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Newark, Delaware

Represented in Canada by DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO

DILECTO

A laminated plastic, commonly known as phenol fibre, made in sheets, rods and tubes or fabricated parts to specifications. Has high electrical insulation properties, great resistance to water, practically unaffected by oil or mild acids. It is a strong, tough material with a wide application for use in connection with modern electrical appliances.

DIAMOND VULCANIZED FIBRE

A tough, economical, insulating material made in standard sheets, rods and tubes. Can be readily fabricated or formed. A material of countless applications.

VULCOID

A thermo-plastic, non-hygroscopic insulating material made in standard sheets, rods and tubes. It is strong and tough, has good electrical insulating properties and is readily fabricated.

MICABOND

Thin splittings of mica bonded together with specially developed binders into standard plates, tubing or in formed rings, punched and sawed segments or other special parts. Micabond has high dielectric strength, is practically unaffected by acids, has high heat and moisture resistance, is readily punched, sawed or formed.

CELLULAK

A laminated form of insulating tubing, possessing extremely high dielectric properties, and marked resistance to flash-over.

DILOPHANE

A translucent, laminated plastic in colors. It provides perfect light diffusion, is not inflammable, and is manufactured in practically any color imaginable with either a glossy or dull finish.

Engineers. His important contribution to the power cable industry has been the stimulation of research and consequently of progress in materials in processing and in design of high-voltage cable insulation.

▶ CLEMENT P. COREY, chief load dispatcher of the New England Power System, Millbury, Mass., has been elected chairman of the System Operators of New England. O. A. Browne, Western Massachusetts Companies, Greenfield, becomes secretary. The new executive committee includes E. C. Brown, Connecticut Valley Power Exchange, Hartford; S. C. Jacoby, Montaup Electric Company, Fall River; L. H. Howe, Boston Edison; William Noyes, Public Service Company of New Hampshire (Manchester), and I. A. Patten, Lynn Gas & Electric Company.

OBITUARY

C. M. Brewer

C. M. Brewer, president of the California Oregon Power Company, died March 2 in Medford, Ore., in his fifty-sixth year. Mr. Brewer entered the public utility industry as salesman in the new-business department of the Commonwealth Power Company. A

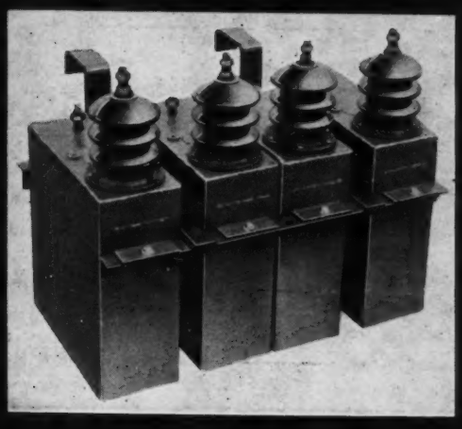
year later he went to Grand Rapids with the Grand Rapids Muskegon Power Company in the same capacity.

In 1909 he became associated with the H. M. Byllesby & Company organization as sales manager of the Muskogee Gas & Electric; in 1910 was appointed sales manager at Mankato, Minn., for Northern States Power Company and was later transferred to Sand Point, Idaho, where he became operating manager of the Northern Idaho and Montana Power Company.

Mr. Brewer was transferred to Richmond, Calif., as manager of the West-

SPECIALIZATION

for 28 years



This much is certain. In whatever way a man—or a group of men—may excel, the world beats a path to that man's door. For he has devoted all his energy, all his ingenuity to some one purpose. He is a specialist. It is out of this constancy of purpose, this specialization, that perfection comes.

For 28 years, Cornell-Dubilier has specialized in the building of capacitors, and capacitors alone. The reward for these 28 years of specialization is a matter of record. *The public utility world today knows that C-D means built-in dependability—dependability which has never failed.*

UTILITIES ARE FINDING IN C-D POLE-TYPE CAPACITORS THE ANSWER TO THE PROBLEM OF INCREASING SYSTEM CAPACITY ECONOMICALLY.

Literature on request at Dept. C12

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CORNELL-DUBILIER

WORLD'S OLDEST AND LARGEST MANUFACTURERS OF CAPACITORS EXCLUSIVELY

Capacitors for Power-Factor Correction

FLEXTEEL CLEVISES

ONLY ONE OF THE OUTSTANDING PRODUCTS IN THE U-S LINE OF CONSTRUCTION SPECIALTIES

Illustrated: Newest of the popular family of Flexteel Clevises. Designed for universal mounting, rigid or flexible. Descriptive folder upon request

Catalog No. 37 Lists the U-S Line of
DISTRIBUTION . . . TRANSMISSION . . . UNDERGROUND and STREET LIGHTING EQUIPMENT

UTILITIES SERVICE CO.
ALLENTOWN PENNA.

ern States Gas & Electric Company. His next position was that of vice-president and general manager of Mountain States Power Company at Albany, Ore., to which he was appointed in 1919. Continuing in that office, he was elected to the same position with the California Oregon Power Company in 1929, moving to Medford. In 1931 he was elected president of both these companies, resigning his position with the Mountain States Power Company last year.

•

▶ PAUL H. DIVER, magnet sales manager of the Ohio Electric Manufacturing Company, Cleveland, Ohio, since the organization of the company, died February 26.

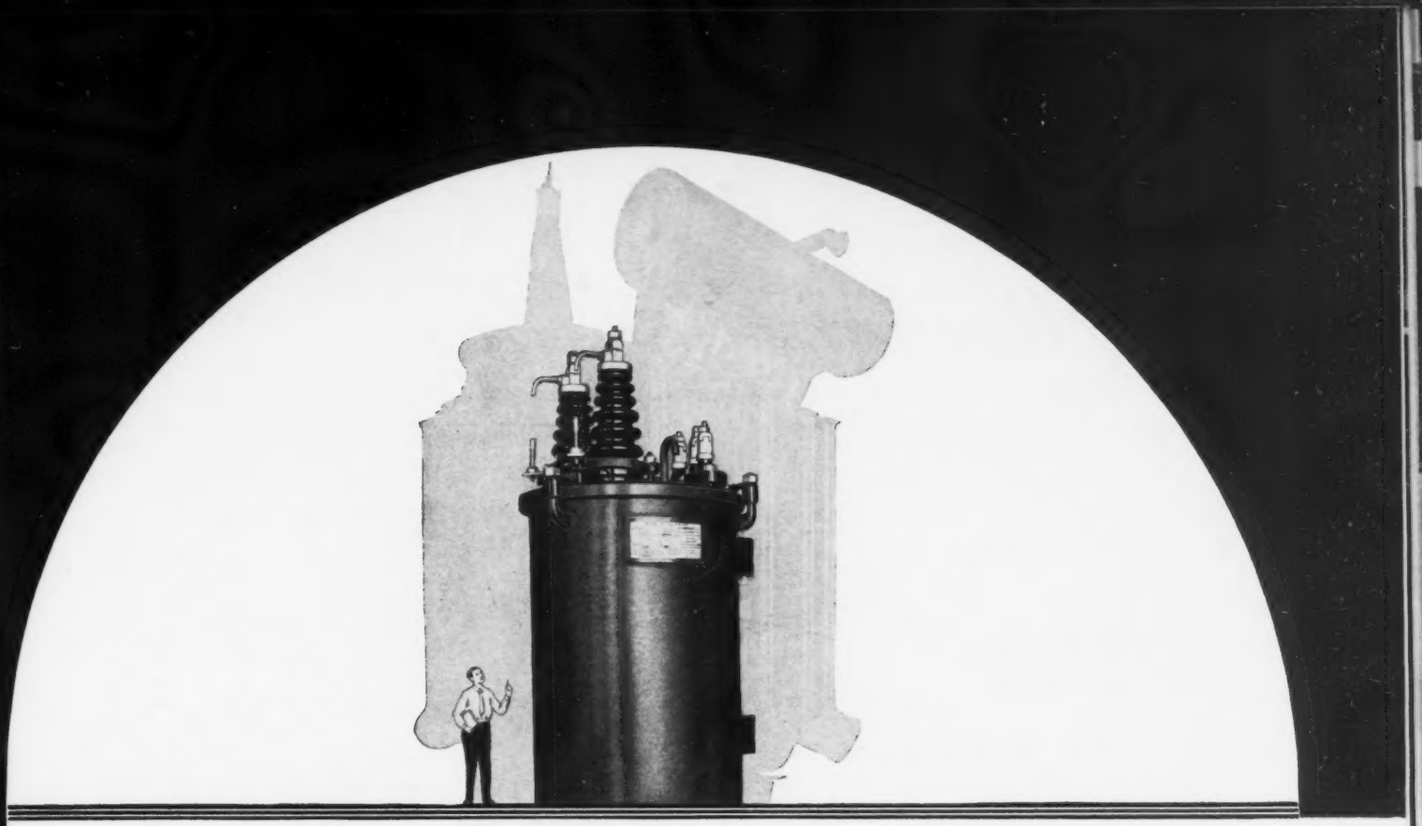
▶ JOSEPH W. KUESER, vice-president of the Knapp-Monarch Company, St. Louis, Mo., died February 24. He was 45 years old. Mr. Kueser assisted in the organization of the company in 1929 and at that time was made vice-president.

▶ PERRY C. TIEDEMAN, vice-president of the Standard Electric Stove Company, Toledo, Ohio, died February 25, in his seventieth year. He had retired from active duty last January following an association with the company of 26 years. He had been vice-president since 1924.

▶ GEORGE S. GIBBS, for the past 35 years a sales engineer in the Boston office of the Westinghouse company, and long in charge of naval and marine equipment business in the New England area, died suddenly at his home in that city February 24. He was born in Grafton, Mass., in 1873; he was a graduate of the Worcester Polytechnic Institute, and had recently been nominated a member of its board of trustees.

▶ IVAN N. PRITCHARD, secretary-treasurer of the Chatham Public Utilities Commission, Chatham, Ontario, died, as the result of an operation, January 14. Mr. Pritchard started to work for the commission when it was inaugurated in 1914 and had a very intimate knowledge of its operations. He was 43 years old.

▶ JASPER E. METCALF, for many years electrical engineer for the Moncton Electricity & Gas Company, Moncton, New Brunswick, Canada, died recently. He had retired several years ago because of ill health. Mr. Metcalf was born 67 years ago at Stilesville, near Moncton. He had been electrical engineer for the city of Moncton before joining the staff of the Moncton Electricity & Gas Company, with which he remained for approximately 27 years.



Built like a Power Transformer!

The Moloney Pivot Type Distribution Transformer borrows from its giant brother... the Power Transformer.

By extending the high voltage bushing shanks below the cold oil level... just as is done on the large Power Transformers... there is provided another distinct advantage of Moloney Pivots over other types of distribution units.

This submerging of the high voltage bushings in oil eliminates the frequent flashovers that occur from the leads to the tank or to the cover... thereby doing away with the outages normally resulting from this cause.

Moloney Pivot Type Transformers are built with the same infinite care and precision as are the Power Transformers... resulting in added years of trouble-free service and economical operation.

Specify **MOLONEY TRANSFORMERS**

MOLONEY ELECTRIC
SAINT LOUIS
TRANSFORMERS

Manufacturing AND MARKETS

General Electric Net Shows Gain In Year

President Swope reports increase in orders and sales in 1937—Orders lower this year

Orders received by General Electric Company during the first two months this year totaled $41,348,000, as compared with $64,229,000 in the same period last year, a decrease of 36 per cent, according to Gerard Swope, president.

Last week directors declared a dividend of 30 cents a share for the first quarter, payable April 25 to stockholders of record March 18.

Preliminary results of 1937 operations showed sales billed of $349,740,000, as against $268,545,000 for 1936, an increase of 30 per cent. Orders received totaled $379,274,000, against $296,748,000 in 1936, a gain of 28 per cent.

Net income higher

Net income was $63,547,000, an increase of 45 per cent and was equivalent to $2.21 a share. This compares with $1.52 a share in 1936. Dividends paid during the year totaled $2.20 a share, as against $1.50 a share in 1936. Taxes for 1937 totaled $23,266,000, as against $15,072,000 for 1936, an increase of 54 per cent. The 1937 taxes included $570,000 for federal surtax on undistributed profits.

Cash and marketable securities totaled $47,536,000, against $92,030,000 at the end of 1936, the greater part of the decrease being reflected in the $33,700,000 increase in inventories. The entire portfolio of marketable securities matures within four years.

Inventories, after reserves, totaled $93,768,000, against $60,049,000 at the end of 1936.

The gross value of the investment portfolio was $174,991,000, as against $214,881,000 a year ago. The balance in investment reserve was $19,215,000, against $72,363,000 last year, and $40,342,000 at the end of 1935. The decrease in market value in securities was charged against investment reserve. After revaluation and deducting the reserve, investments were carried at a net value of $155,776,000, against $142,518,000 at the end of 1936.

Additions to plant and equipment during the year amounted to $20,593,000, against $8,621,000 in 1936. The general reserve was $19,095,000, against $18,181,000 and earned surplus was $121,457,000, against $121,484,000 at the end of 1936.

The average number of employees during 1937 was 75,212, against 61,781 in the preceding year. Total earnings of these employees amounted to $145,358,000, against $106,784,000 for 1936, a gain of 36 per cent. The average annual earnings were $1,933, against $1,728, in 1936, and were the highest in the history of the company, being 4 per cent greater than in 1929, notwithstanding fewer working hours. Average annual purchasing power was 23 per cent higher than in 1929.

Stockholders at the end of the year totaled 201,219, against 190,044 on November 27, 1936.

•

Cut in Dividends Conserves Capital

Babcock & Wilcox Company in declaring a dividend recently made the following announcement:

"Various considerations indicate that operations for the first half of this year will show a loss. Under the circumstances and in view of the advisability of conserving working capital, directors declared a dividend of only 25 cents." In 1937 five dividends of $1 each were disbursed.

Directors of the Johns-Manville Corporation took no action this week with respect to a dividend on the common stock, but declared the regular quarterly dividend of $1.75 a share on the 7 per cent preferred. Lewis H. Brown, president, said the omission of the common dividend was caused in part by the effect of the current business recession upon the sales of the corporation and in part by the dividend actions taken previously as a result of the federal tax on undistributed profits.

Installation Costs Pass Low Point

"We passed the low point in the cost of large air conditioning installations more than a year ago," said L. R. Boulware, vice-president and general manager of the Carrier Corporation, recently before the Illinois Hotel Association.

"Contrary to the general impression that the cost of air conditioning is going to show the same price decreases, through savings in manufacture, as in the cases of automobiles and refrigerators, the large air-conditioning installations are inseparably tied with the building industry in materials, methods and habit of mind, and while volume will bring some saving in man-hours expended on manufacturing the equipment, the rising costs for material, labor and taxes on the manufacture tend to offset this. Also, the materials the air-conditioning manufacturer produces account for only 25 per cent to 35 per cent of the completed job, the remainder of the cost going for tailor-made work on the job, and the cost of this latter is of course also increasing. . . ."

•

Sets Up Distributing Point

To meet requirements of expanding business in the eastern sector of the country, The Trane Company of La Crosse, Wis., manufacturer of heating, cooling and air conditioning equipment, has leased space at Bush Terminal in New York City for warehousing and assembly facilities. Orders thus far placed, together with business prospects for the balance of the year indicate a heavy volume of air conditioning in 1938.

•

Electrical Machinery Sales Off 11 per Cent in January

Manufacturers' sales of electrical machinery, apparatus and supplies during January, 1938, as reported by 16 firms, totaled $6,684,000, a decrease

SERVICE Entrance and Drop Cables made by the American Steel & Wire Company have been designed to reduce the cost of service change-overs involved in the installation of ranges and other appliances in homes, and to eliminate current diversion.

Our "Tamperproof" types have a concentric bare neutral conductor applied over the insulated conductors which makes it difficult to divert current without causing a short circuit between the inner and outer conductors when the cable is cut. The "Tamperproof" types (SD and SE) are approved by Underwriters for circuits not exceeding 150 volts to ground.

Type ASE is designed primarily for use under conditions where the Code calls for an entrance cable of the "protected" type. Type USE, for underground entrances, can be buried direct in earth without ducts or other external protection. Type ASE is also approved for this same purpose.

For full information on our Service Entrance and Drop Cables write for Bulletins No. 102 and 104.

SERVICE ENTRANCE *and* DROP CABLES

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Yet It Harms Nothing Else

Here's how the electrical industry keeps two jumps ahead of fire. Up-to-the-minute plants use LUX carbon-dioxide snow-and-gas —fastest known extinguishing agent.

Lux portable extinguishers and Lux Fixed Systems kill dangerous fires in *a few seconds. Lux harms nothing* —there's no wetting, no corrosion, no fumes.

Get Lux protection promptly. For all electrical fire hazards.

LUX
SNUFFS OUT FIRE

YOU WILL be interested in reading "Lux Makes The Difference", a description of Lux Portable extinguishers and Lux Fixed Systems. Write today for your free copy.

Walter Kidde & Company
30 West Street, Bloomfield, N. J.

of 11 per cent, compared with December, 1937, and a decrease of 14 per cent, as compared with January, 1937, according to the Department of Commerce.

Wholesalers' sales of electrical goods during January, 1938, as reported by 301 firms, amounted to $13,572,000, a decrease of 35 per cent, compared with December, 1937, and a decrease of 12 per cent, as compared with January, 1937. Stock-sales ratio for January, 1938, was 193, against 126 for December and 155 for January, 1937.

•

G.E. Cuts Capacitor Prices

Price reductions on capacitors of as much as 18 per cent, depending on their ratings, have been announced by the General Electric Company, and are said to bring the average price of capacitors to less than 40 per cent of the 1929 level.

•

Vacuum Cleaner Sales Up

Electrical vacuum cleaners sold in January totalled 118,127 compared to 117,810 in the preceding month and to 124,576 in January, 1937, C. G. Frantz, secretary of the Vacuum Cleaner Manufacturers' Association, has announced. "This was the second highest January in the industry's history," Mr. Frantz said.

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Refrigerator Sales Drop

Domestic sales of electric household refrigerators during the month of January totaled 97,640 units, compared with 159,417 units in January, 1937, according to an announcement made by the National Electrical Manufacturers Association. World sales amounted to 106,861 units in January, compared with 172,758 units in January, 1937.

•

Awarded Meter Contract

Westinghouse Electric & Manufacturing Company has been awarded a contract by the Light and Water Department, Memphis, Tenn., for watt-hour meters at $55,275, to be used in connection with the new municipal distribution system.

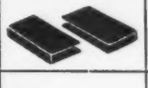
New York Metal Prices

	Mar. 2, 1938 Cents per Pound	Mar. 8, 1938 Cents per Pound
Copper electrolytic	10.00*	10.00*
Lead Am. S. & R. price	4.50	4.50
Antimony	13.75	13.75
Nickel ingot	35.00	35.00
Zinc spot	5.10	5.10
Tin Straits	41.75	41.625
Aluminum, 99 per cent.	20.00	20.00

* Delivered Connecticut Valley.

Check these Possibilities for Product Improvements

WITH MICANITE INSULATING SPECIALTIES

MICANITE AND SUPER-MICANITE FOR	RINGS AND SEGMENTS, CONDENSERS	STAMPINGS, SEGMENTS	RINGS AND MOULDED FORMS	FLEXIBLE SHEETS	CLOTH, PAPER-ROLLS, SHEETS, TAPE	HEAT-PROOF AND HEATER PLATE	FORMED PIECES, TUBING, WASHERS
MOTORS, GENERATORS							
COMMUTATORS							
ARMATURES, COILS, STATORS							
TRANSFORMERS							
CONTROL APPARATUS							
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SEND FOR TEST SAMPLES FOR YOUR OWN PRODUCTS

THE CHART above can only begin to show the variety of Mica combinations which are effecting valuable improvements in the insulation of electrical equipment.

But, to alert manufacturers, it will suggest many more possibilities for bettering the performance and increasing the sale of their products.

Mica, in combination with other materials, is being made to meet a wide variety of specific requirements. Let us know the application you have in mind and we'll gladly send suitable material for a test in your own plant. Address Dept. #31.

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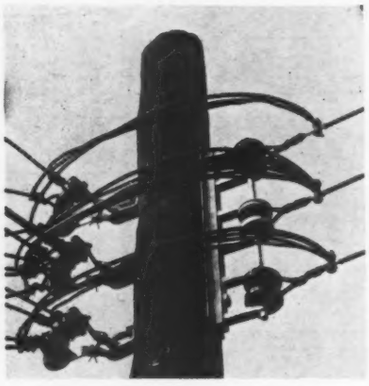
MICA INSULATOR COMPANY

MICANITE . . . EMPIRE VARNISHED INSULATIONS . . . LAMICOID LAMINATED PLASTIC MATERIALS

Reliable

MULTIPLE TAP CONNECTOR

NEAT ECONOMICAL



The Reliable Multiple Tap is a special Connector for joining Service Drop Pigtails to Main Secondary Conductors in Alley Distribution where several Drops run from one pole.

One size accommodates a No. 2 line and six No. 6 Taps in a close fitting slot that assures dependable connections.

Write for details and prices.

Reliable ELECTRIC COMPANY
OVER 25 YEARS SERVICE TO THE UTILITIES
3145 CARROLL AVENUE · CHICAGO, ILLINOIS

Field Reports on Business

The electrical industry is looking forward to a pick-up in electrical appliance demands this spring as utilities add impetus to present campaigns. Heavy equipment orders have failed to make their appearance in large volume as utilities await a clarification of the government's program.

NEW YORK

Further declines were registered last month in many lines of trade. Industry leaders feel that the uncertainty of government policy and aims, which has spread to the general buying public, is responsible for the present situation. That purchasing power is not lacking is seen in selective purchases which are being made at the bargain sales counters.

In the heavy industries management feels that expansion or rehabilitation programs should be held up pending a clarification of spring and summer trade outlook. The public utilities are holding back their construction programs until after the SEC-Electric Bond & Share decision from the Supreme Court.

The present situation in the TVA has put a damper on enthusiasm to expand facilities. It is felt that what happens in the TVA area is likely to happen in other parts of the country should President Roosevelt get his 7-TVA plan approved by Congress.

Utility companies are devoting their main efforts in appliance sales campaigns. Sales in January and February indicated that the four-month decline was arrested, although totals remain 8 to 15 per cent under the 1937 period. Under the stimulus of spring campaigns, it is felt that the appliance market will show an upturn. Wholesale volume is low because of lack of commitments from public utilities.

NEW ENGLAND

Some features of encouragement stand out in the New England business picture, which at the moment is characterized by gradual declining interest in orders for electrical equipment. Requests for information on costs of heavy power equipment for contemplated plant expansion outside of this area are being received in fair volume and are keeping a number of engineering specialists busy in the preparation of estimates. A number of machine tool manufacturers report an increase in inquiries for machines and are negotiating for small motors up to 5 hp.

Recently one manufacturer placed several small lot orders for fractional motors, one of which amounted to about $1,200 for a well-known manufacturer in Massachusetts, another lot covered eighteen ¼-hp. motors last week.

A Westinghouse automatic and remote control installation is being installed at the Patch hydro station of the Vermont Public Service Corporation. A new 44-kv. tie line is contemplated for southern Vermont. A prominent representative reports an increase in orders for prepayment meters. New lighting equipment will be required for the Boston city hall, estimated, in connection with improvements, at $100,000. New lighting fixtures for several large institutional buildings now being erected will be purchased soon, notably for the new Northeastern University building and the new Massachusetts Institute of Technology architectural building.

Merchandise sales are at a low level. One manufacturer records an increase in inquiries for large electric dishwashers to be used in institutions. New refrigerator models are attracting some attention, but buying is lagging behind last year.

PACIFIC COAST

Despite such adverse factors as a short month, continual rain, holidays and widespread tendency to forego the usual first of the month stock order, February business ran abreast of January and a general pick-up during the last week was evident. Dealers are contracting for a greater volume of refrigerators than they did in 1937 and are hopeful over this season's prospects. Small appliances leaders are finding ready purchasers, proving that the recession will reverse itself when consumers overcome their ultra caution. There has been no marked decrease of employment.

Disastrous floods in the Los Angeles area will necessitate a $25,000,000 rebuilding program. Several exceptionally large public purchases and projects are reported, including structures for electric repairs and cable to be erected for $1,000,000 by the Los Angeles Water and Power Department; contracts covering a $76,000 Pelton turbine and a $102.257 Allis-Chalmers generator, both to be installed by the government at Kendrick, Wyo., and a low bid of $135,795 for sixteen motor-driven pumping units for the Contra Costa Canal of the Central California Valley project.

Los Angeles is contemplating street lighting standards for several new avenues and a three-mile installation of experimental highway lighting has been completed just south of the San Francisco County line.

CHICAGO

Electrical manufacturers report a continued decline in the volume of sales throughout the Middle West. Very little heavy equipment is now being delivered and inquiries have fallen off sharply. Industrial production is approximately 35 per cent below what it was a year ago, with no indication that the present downward trend will be reversed. The small seasonal expansion usually experienced at this time of the year, particularly in the manufacturing industries, has failed to materialize.

Employment and wages in Illinois declined sharply last month. Employment was 7 per cent below the same month a year ago and payrolls were off 8 per cent. Although retail trade registered a slight gain over the previous week, the average is 18 per cent below last year at this time.

Utility construction programs are still being deferred and expenditures are more closely watched. Another construction job, including $350,000 for electrical equipment, for a large packing house has been temporarily postponed.

Small appliance sales are fairly steady, running approximately 10 per cent under last year. Radio sales are lagging and production has dropped over 50 per cent. Electric razors are increasingly popular, one manufacturer having orders on hand sufficient for over three months production.

The meters of today

FOR THE LOADS OF TO-MORROW

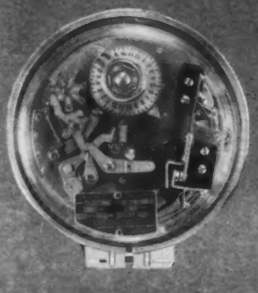
• Featuring electric water heaters in show windows and display rooms is a good start toward solving the problem of merchandising off-peak load builders.

• And after the rate is determined, measuring and controlling equipment is easily selected from designs already proven in field service. For straight off-peak rates, the measuring and controlling can be done by a single unit, a time-controlled meter; or, by two units, a meter and a time-switch. For two-rate service, there is the time-controlled two-rate meter; or, a meter with two-rate register, and a separate time-switch.

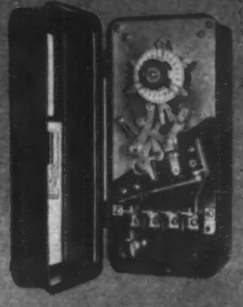
• Thus, the meters and time-controls of today fit conveniently into your future load building programs.

Time-controlled Meter.

Time-controlled Two-rate Meter.

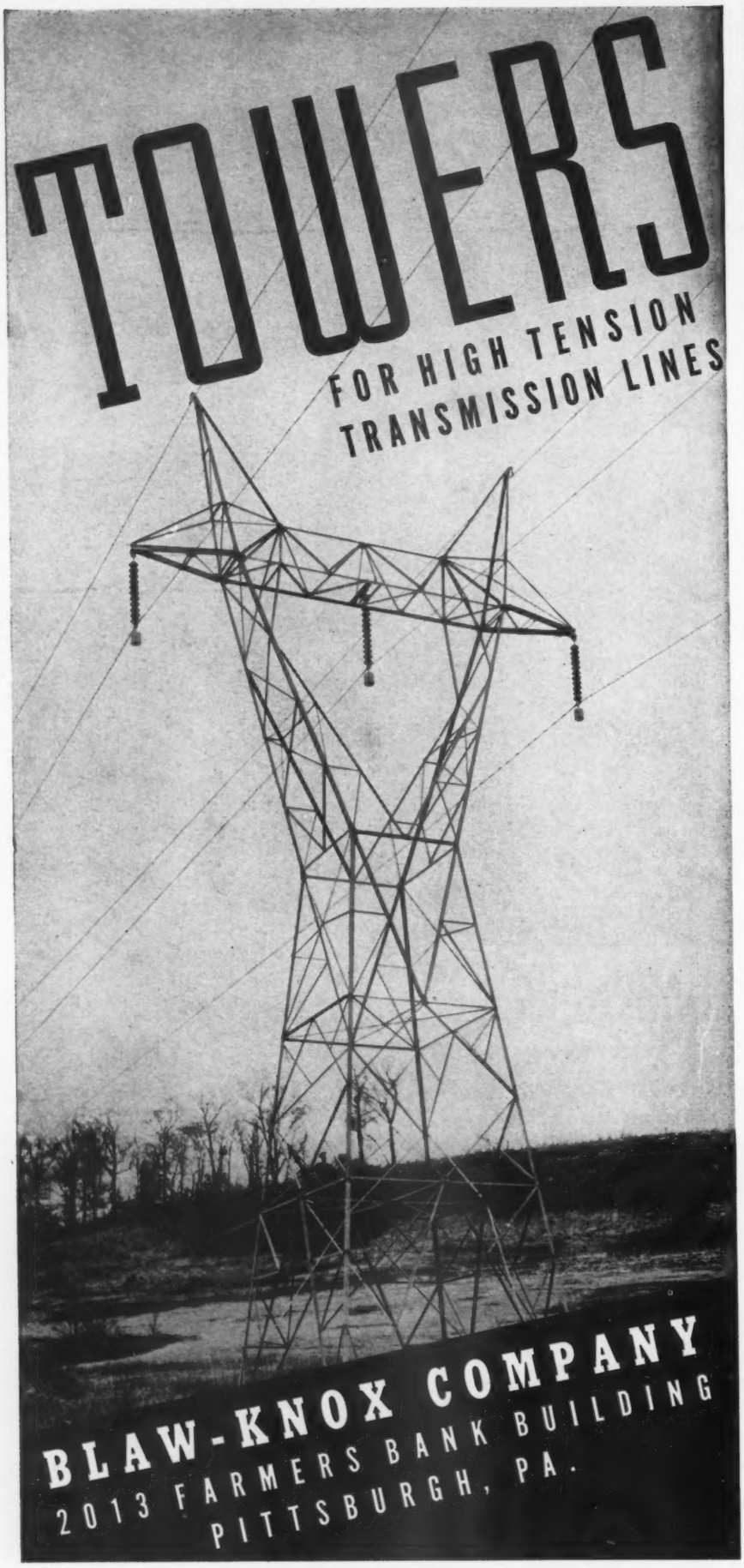


Model F Socket Time-Switch.



Form K Synchronous Time-Switch.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS



Municipal Plants

MAQUOKETA, IOWA—Judge F. D. Kelsey of the Jackson County District Court has granted a temporary writ of injunction against the city, restraining it from proceeding with the proposed construction of the $96,000 municipal power plant improvement program to be financed by REA. The plaintiffs charge that the city did not make proper specifications to bidders and that the council delegated too much power to REA. Among the plaintiffs are the Iowa Electric Company.

JEANERETTE, LA.—City Council is planning installation and operation of municipal electric light and power plant. Committee has been appointed to investigate cost and has been instructed to make early report.

ALLEGAN, MICH.—Consumers Power Company has won its fight to leave its poles and wires in the streets of the city as the result of a decision of Judge Fred M. Raymond in the Grand Rapids Federal Court. Judge Raymond also held that the municipal light plant might continue to operate its hydro-electric plant at the present water level. The court denied the claim of the power company that it was entitled to 5 per cent interest on a condemnation award of $12,080 against the city. In its suit to force removal of the light poles and lines, the city argued that the power company's franchise expired in 1932. The company claimed a continuing right to do business on a statutory franchise emanating from the state, and Judge Raymond upheld the company.

COLUMBUS, MISS.—TVA has submitted a contract to the city for study with a rate structure representing a reduction of 50 per cent from existing rates, Mayor T. W. Harris of Columbus has announced. Steps have been taken with the Mississippi Power Company to conclude negotiations for purchase of existing distribution systems, the Mayor said. If conference does not bring an agreement, the city is to build its own system under authority of a bond issue approved at the polls last fall.

SUPERIOR, NEB.—Southern Nebraska Power Company is concluding arrangements for the sale of its generating plant to the Ceneral Nebraska Public Power and Irrigation District for a cash consideration of $898,000, a sum which has been determined by a physical appraisal of engineers for the purchasing organization. The book cost of the plant and line facilities included in the sale is $1,665,738.

ENDICOTT, N. Y.—Board of Trustees at a meeting held recently authorized negotiations with the New York State Gas & Electric Corporation for the sale by the village of the municipal electric plant to the utility company. The state Public Service Commission recently ordered electric rates of the municipal plant reduced $12,000 annually.

ADAMS, WIS.—Circuit Judge A. C. Hoppmann at Madison took under advisement the case between the state Public Service Commission and the Wisconsin Power & Light Company involving the utility's power plant and distribution system. The utility appealed to the Circuit Court after the commission overruled its contention that since Adams and Friendship are being served from the same

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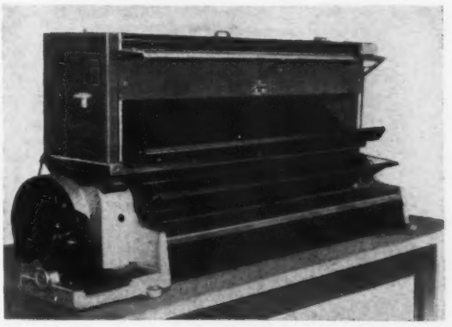

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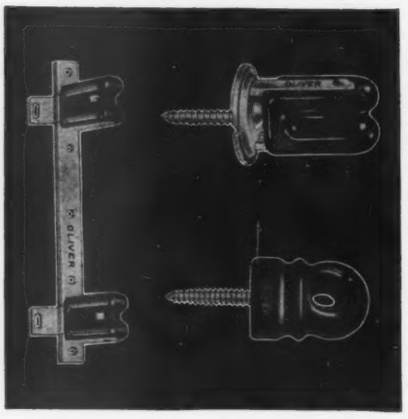

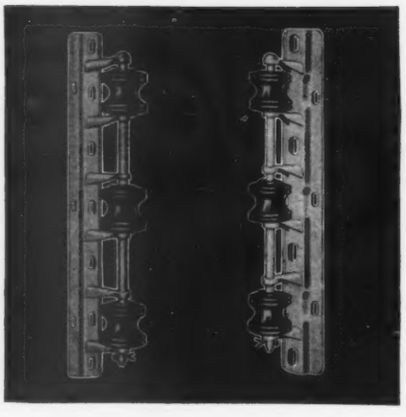

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plant, they must form a power district before starting action to purchase its plant.

SCHULLSBURG, WIS.—Interstate Light & Power Company has informed the state Public Service Commission that it has dropped its court appeal from the commission order setting $18,000 as the price at which the city may purchase its plant. The city now has four months in which to complete acquisition of the plant.

PLAIN, WIS.—Citizens have petitioned Gov. Philip LaFollette to render assistance in the village's action to sell its electrical utility property to the Wisconsin Power & Light Company. The city has contracted to sell its plant to the utility for $35,000 but the state Public Service Commission refused to approve the sale. Petition asserts that the village plant is overloaded and that the village does not wish to incur additional debt.

SUPERIOR, WIS.—Hearing on the utility revaluation case was closed recently by the state Public Service Commission. Evidence was taken at the hearing to determine the procedure used in fixing a $4,600,000 value on the three plants of the Superior Water, Light & Power Company. The price is being contested as excessive in the Dane County Circuit Court. One of the reasons for reopening this case, it was disclosed by the commission, has been to determine whether B. E. Buckman & Company, defunct Madison investment house, had any connection with it.

WAUPACA, WIS.—Action by the Wisconsin Public Service Corporation to have set aside a public service commission order setting the price to be paid by the city for the electric utility its citizens voted to purchase has been taken under advisement by Circuit Judge A. C. Hoppmann at Madison. The utility alleges that the commission, which set a $225,000 valuation on the property and $65,000 on the high line and part of a substation at Stevens Point, has no jurisdiction in the case.

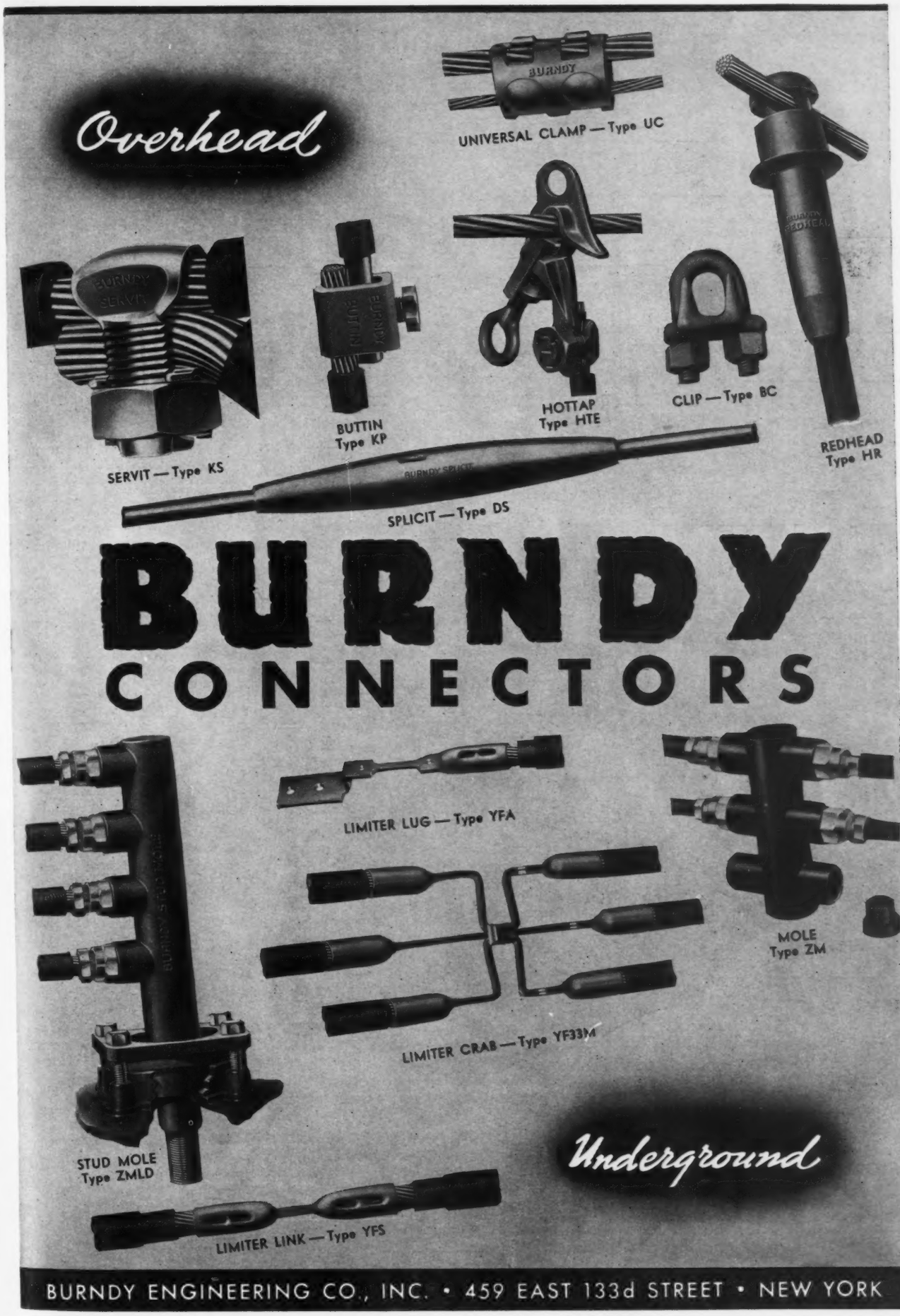
WISCONSIN—Ten towns and one village in Washburn County have advised the state Public Service Commission that they desire to form a municipal power district. The commission has 90 days in which to study the proposed district and report on its feasibility.

SOUTH NORFOLK, VA.—Though City Council passed through final reading the contract between the city and Virginia Electric & Power Company, which would have shelved for the next ten years the matter of a municipally owned power plant, Mayor J. J. Davis vetoed the contract. Mayor Davis in his veto declared that "after long and serious study I am convinced that a municipally owned power plant would be an invaluable asset."

•

Adds New Unit to Holdings

Specialty Transformer Company, Newark, N. J., has taken over the Newark Transformer Company of that city. M. J. Herold is president. The company is now manufacturing air and oil cooled transformers to 500 kva. and all types of special transformers.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Sales Opportunities

WASHINGTON, D. C.—Constructing Quartermaster, Munitions Building, receives bids until March 24 for installation of outline lighting system at Bolling Field, D. C. (Proposal 6342-15).

QUINAULT, WASH.—Quinault Power Company plans transmission lines in Quinault Valley area, including power substation and switching stations. Line will connect with new hydro-electric generating station of company to be constructed in vicinity of Ewell's Falls on Ziegler Creek. John Cunningham and F. S. Ziedlhack, Spalding Building, Portland, Ore., are consulting engineers.

KANSAS CITY, KAN.—Board of City Commissioners plans installation of motors and controls, regulators, transformers and accessories, switchgear, electric hoists, electric cranes, conveyors and other equipment in new bulk food terminal on Kaw River, Public Levee district, comprising group of five one and multi-story units. An electric-operated refrigerating plant will be installed for one of buildings. Cost about $4,250,000. Financing is being arranged through Federal aid. Alonzo H. Gentry, Voskamp & Neville, Inc., 4 West Thirteenth Street, Kansas City, Mo., are architects; Joseph W. Radotinsky, Commercial National Bank Building, Kansas City, Kan., is associate architect.

DECATUR, ALA.—Will ask bids soon for a municipal electric distribution system, with power substation and transmission line for connection with TVA high-tension system, which will furnish service. T. M. Francis, Brown-Marx Building, Birmingham, Ala., is consulting engineer.

NEW YORK, N. Y.—Consolidated Edison Company has taken out a permit for alterations and improvements in seven-story steam-electric generating station at 320-26 West 201st Street. Cost about $250,000. T. R. Galloway is company engineer in charge.

DENVER, COLO.—Bureau of Reclamation has plans under way and receives bids soon for power lines from Seminoe power dam, Kendrick, Wyo., reclamation project, to Casper and Cheyenne, Wyo., with extensions to Scottsbluff, Neb., Greeley, Colo., and other points in Northern Colorado, including power substations, switching stations and other operating facilities.

CHICAGO, ILL.—Jordan Company, 2630 West Arthington Street, plans installation of motors and controls, conveyors, electric pumping machinery, electric hoists and other equipment in new multi-unit acid and chemical plant at Clarendon Hills, DuPage County, where site has been secured. Cost over $350,000. N. Ronneberg, Inc., 10 South La Salle Street, Chicago, Ill., is architect and engineer.

WASHINGTON, D. C.—Procurement Division, Public Buildings Branch, Treasury Department, plans installation of motors and controls, transformers and accessories, electric hoists, conveyors and other equipment in new addition to local Government Printing Office. Cost about $2,000,000. Appropriation in that amount is being arranged, effective with Federal fiscal year, beginning July 1, 1938.

GULFPORT, MISS. — Mississippi Power Company, Gulfport, plans extensions and replacements in transmission lines in different parts of territory during 1938, to cost $187,150, including power substation facilities. Also will build new rural electric systems during same year, including

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primary and secondary lines and power substation facilities; an appropriation of $395,500 is being arranged for latter work.

CHICAGO, ILL.—Commonwealth Edison Company has plans for alterations and improvements in Lakeview power substation, for which work will begin soon. Also plans are maturing for two new power substations, at California Avenue and Roscoe Street, and on Ardmore Avenue, respectively. Cost over $60,000, each, with transformers and accessories, switchgear and auxiliary equipment. Sargent & Lundy, 140 South Dearborn Street, are consulting engineers.

ROANOKE, VA.—Appalachian Electric Power Company will soon begin work on 1938 rural electrification program, comprising about 115 miles of primary and secondary lines, with power substations and service equipment. Cost over $130,000.

COZAD, NEB.—Plans municipal electrical distributing system, with power substation facilities and transmission line connection for power supply. Cost about $200,000. C. Robert Fulton, 2327 South Nineteenth Street, Lincoln, Neb., is consulting engineer.

FRESNO, CALIF.—San Joaquin Light & Power Corporation has authorized new 110,000-volt power transmission line from LeGrand to Mendota, Calif., with power substations and switching stations. Extensions and improvements will be made in primary and secondary lines at Bakersfield, Taft and San Luis Obispo, with additional service facilities. Cost over $500,000. This is part of 1938 expansion program of company.

OKLAHOMA CITY, OKLA.—Oklahoma Gas & Electric Company has authorized extensions and improvements in 1938 to cost about $2,860,000, including additions and replacement in transmission lines, to cost about $180,000; also for primary and secondary lines for city and rural service, to cost $1,675,000, with power substations and service facilities. Extensions and betterments will be made in power substations at Fort Smith and Oklahoma City, with installation of transformers and accessories, switchgear and other equipment.

YORK, NEB.—Plans new municipal electrical distribution system, with power substation facilities. Cost about $400,000. Special election is being arranged to vote bonds in that amount. C. Robert Fulton, 2327 South Nineteenth Street, Lincoln, Neb., is consulting engineer.

HARTSELLE, ALA.—Receives bids until March 24 for a municipal electric distributing system, including power substation and transmission line for connection with TVA power system, which will furnish service. Lide & Adler, Woodward Building, Birmingham, Ala., are consulting engineers. Financing has been arranged through Federal aid.

•

German G.E. Pays Dividend

The Allgemeine Elektrizitäts Gesellschaft of Berlin is paying a dividend for the year ended September 30 last of 4 per cent, the first since the 7 per cent for 1929–30. The company's turnover advanced to 397,000,000 marks ($165,415,000), against 316,000,000 marks ($131,665,000) in 1935–36. Net profits totaled $7,500,000 marks ($3,125,000).

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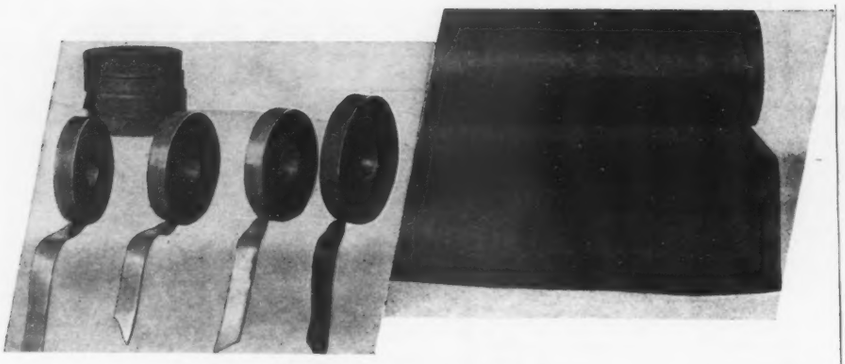

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BOOK REVIEWS

Transformer Principles and Practice

By J. B. Gibbs, Published by McGraw-Hill Book Company, 330 West 42d Street, New York. 210 pages, illustrated. Price, $2.50.

Those who have to apply and operate transformers may not be concerned about the refinements of their design. For them there is this simple but adequate book about what goes into transformer assemblies and how they can be applied and maintained satisfactorily. Cooling, the bearing of polarity on connections, various single-phase and polyphase connections and phase transformations, certain unconventional connections, the possibilities of auto-transformers are covered concisely in corresponding chapters.

What transformer oil is, how to test it and preserve its qualities are matters treated in practical manner; construction to withstand mechanical forces and surges along with methods of testing transformers follow, and then are inserted extracts from standard prescriptions on care and operation. Closing chapters consider the economic benefits of replacing earlier inefficient transformers by modern, efficient designs.

•

Modern Weights and Measures

By W. R. Ingalls. Published by American Institute of Weights and Measures, New York. 72 pages. Price, $1, postpaid.

This is a defense of the English system of weights and measures prevailing in our commerce, manufacturing, engineering and education. Equally it constitutes an historical, practical and argumentative refutation of the merits advanced on behalf of the metric system by the International Chamber of Congress. The metric system has been legal in this country for more than 70 years and the author makes much of the fact that it has made little progress despite the convenience claimed for it.

•

Air Conditioning in Summer and Winter

By Richard E. Holmes. Published by McGraw-Hill Book Company, 330 W. 42d Street, New York City. 287 pages, illustrated. Price, $3.

It is a customary characteristic of texts created for specifically trained students that they begin at the beginning and end where those exposed can be assumed to have acquired intensively the indispensable knowledge of the subject. Men preparing for the air-conditioning industry during the past two years have taken this author's course at the Springfield Westinghouse plant. Properties of the air we breathe and its content of moisture are treated from the physics and physiology standpoint in two opening chapters. The comfort aspect is built on these, the book proceeds to discussion of prevailing air-conditioning systems and then the methods of computing the load from known conduction and loss conditions are developed in detail.

Conventional heaters and heating systems are discussed both for their own sake and for correlation with air conditioning, mere humidification or mere cleansing of the circulated air. Refrigerants, refrigerating systems and refrigera-

tion principles are set up for their adaptation to the summer air-conditioning job. A final chapter deals with controls for temperature and humidity.

There is ample tabulated data and a sufficiency of numerically solved problems to guide the engineer-salesman into competency in his vocation if he absorbs and applies the practical approach provided here. Equipment is reasonably representative of a variety of manufacturers, with Westinghouse, however, naturally dominating.

•

National Electrical Code Handbook

Fourth edition (based on 1937 code). By Arthur L. Abbott, Published by McGraw-Hill Book Company. 561 pages, illustrated. Price, $3.

Each edition of the National Electrical Code is being followed by the publication of this handbook, which is rearranged in the fourth edition to conform to the new arrangement in the 1937 code. As before, it clarifies the obscure requirements of the code by discussion, by example and by illustration of equipment and thus serves as an interpretive reference source at wherever points the code is more rigorous than self-explanatory.

•

The Income Structure of the United States

By Maurice Leven. Published by the Brookings Institution, Washington, D. C. 177 pages. Price, $1.50.

Whatever may have been the group distribution of individual incomes previous to 1929 it has been changed profoundly by the events of 1929–1936. This analysis essays to depict the present status and to ferret out the factors which determine or, at least, influence the present distribution pattern. It does so for occupational, geographic, sex and race groupings, not ignoring the secondary incomes from other sources than direct wages. The effects of industrial disputes and of technologic innovations are incorporated and much is made of immobility of supplanted labor. It is estimated that industrial disputes caused a loss of at least 28,000,000 man-days in 1937. Weekly earnings for May, 1937, of those employed in 21 manufacturing industries is found to be about 2 per cent less than the 1929 average. Partial data show the total national income for 1937 to have been within $5,000,000,000 of the 1929 total of $81,000,000,000. The appendix has twenty pages of tabulated statistical data.

•

Electrical Measurements

By Frank A. Laws. Published by McGraw-Hill Book Company, 330 West 42d Street, New York City. 739 pages, illustrated. Price, $6.

Professor Laws' associates finished what his regrettable death interrupted—his revision of the 1917 edition of a book which in the interim has remained dominant and unique in its field. That field is the laboratory type of measurement of electrical quantities and electrical circuit elements and the objective is rigor and comprehensiveness in technique rather than mere refinement in accuracy of measurement. Many of the classical methods and equipments have been retained for historical completeness, but not at the expense of introducing modern facilities and procedures. Bibliographies have been greatly expanded and likewise include the latest references.

Current measurements, resistance devices and measurements, potential and voltage measurements, power, inductance and capacitance measurements occupy the first seven chapters and then follows a 60-page chapter on watt-hour meters and demand meters. One chapter is devoted to power factor and reactive metering and discusses the consequences of unbalance and the symmetrical component methods of measuring it. Instrument transformers, instrument calibration, wave form determination and cable testing methods complete this reasonably advanced text devised originally for Massachusetts Institute of Technology junior class students and geared accordingly in mathematical tooling.

•

Carbon Brushes

By Dr. J. Neukirchen, translated by E. I. Shobert II. Published by Stackpole Carbon Company, St. Marys, Pa. Obtainable from the Telegraph Press, Harrisburg, Pa. 166 pages, illustrated. Price, $3.

Brush phenomena could less profitably be expounded through mathematical analysis than, as is here done, by rationalization and reconciling of the experience with the mechanics, geometry, chemistry, electrolysis and thermal behavior of the materials involved. Not all American engineers will accept the conclusions reached, but nevertheless the book is a niche-filling volume for the operator who refuses to be content with the old timer's advice, "change the brushes," but wants to know which of a dozen or more other variables to alter for the sake of better performance. Part I deals with wear, polish, pitting and arcing as a surface and substance matter. Next we find how brush vibrations, chatter, movement and deformation can be ameliorated, or at least explained. Commutation and sparking and burning are the subject matter of the third section.

•

How to Deal With Organized Labor

By A. Feller and J. E. Hurwitz. Published by the Alexander Publishing Company, Inc., New York. 678 pages. Price, $6.50.

No employer will find much direct solace in this book. But indirect comfort will come from learning explicitly what he may not do without running afoul of the National Labor Relations Act, N.L.R.B. or a union. The two lawyer-authors have packed into the middle third of their book case after case of decisions (NLRB and courts) on well over a hundred specific substantive provisions of the act. Here the reasoning of witnesses and the board are given so thoroughly as to reveal the degree to which the board extends the act's safeguarding of the employee in its administration of its provisions. Opinionation of the authors does not intrude; handling is factual and excerpting is well coordinated. Thus have they kept to their preface promise to deal "with sober facts, not with fanciful theories."

Part I traces the origin, evolution and objectives of the American labor movement, therewith treating the forms of union organization and their strategy of functioning in connection with strikes and with trade associations. The ensuing third (Part II) relates the circumstances which culminated in the N.L.R.A.

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as a new public policy expression of federal responsibility in labor relations and then, by case treatment, elucidates its substantive provisions and explains how NLRB performs its functions.

How management can continue a positive and constructive defence is suggested in Part III—"suggested" because the authors, fair as they strive to be, seem to discover little except "est ist verbotens" to build a constructive program upon. Here is, however, offered a valuable syllabus of the clauses which labor believes a collective agreement should contain and the reasons are pretty blunt and specific. The NLRA in full and the rules of NLRB are in an appendix.

Quotable quotes: "A worker . . . needs his job more than his employer needs his services." "The A F of L and the CIO alike have shown an unyielding determination to operate within the framework of the capitalistic system. . . ." "It is implied (in NLRA) that Congress believes management needs no present safeguards in its relations with labor . . . the Act does affirm the underlying basis of the capitalistic system."

•

"Labor's Road to Plenty"

By Allen W. Rucker. L. C. Page & Company, Inc., Boston, Mass. 221 pages, 20 charts and 30 tables. Price, $2.50.

Based on the enduring thesis that the compensation of labor must in the long run be a function of production under the American system of industrial economy and free enterprise, the author shows that the "Pay - Proportionate - to - Productivity - principle" offers a fundamental approach to the mutual prosperity of both labor and capital. The limitations of industrial regimentation and attempted political direction of business in the name of economic uplift are set forth and exposed as shallow means of dealing with today's complex problems of manufacturing and distribution. The author, a well-known contributor to business thinking and market analysis, substitutes for outworn reactionary grasp of profits in excess of equitable treatment of employee compensation a method of co-operation between labor and capital keyed to production which shines through the fog of current political economic waverings like a searchlight through a winter night.

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Segmental Functions, Text and Tables

By C. K. Smoley. Published by C. K. Smoley & Sons, Scranton, Pa. 440 pages. Price, $5.

Structural designers and draftsmen will appreciate this tabulation of quantities (and their logarithms) having to do with circular segments. The introductory text sets up the geometric and trigonometric formulas and then very explicitly explains how to find in the several tables the remaining quantities when any two of the five are known. The major tabulation gives logarithms of all segmental functions by one-minute intervals to 180 deg. Arc lengths and areas are given for the same angular range. Part two consists of reprints from the author's parallel tables of logarithms, squares, cubes, feet and fractional inches, etc.

Circular segments have always been irksome to compute. This handy compilation of direct solutions puts them over on the agreeable side occupied by the polygons.

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NO LONGER A PROBLEM OR A HAZARD

THE CHANCE ROCK ANCHOR

The troubles and hazards of rock anchor installation are practically eliminated with the Chance Rock Anchor. It requires no lead or concrete. Just drill the hole, drop the anchor in the hole and expand by turning the rod. It wedges in and holds tight.

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TIPS GRIP-ALL CLAMP STICK

Tips Grip-all Clamp Stick will handle hot clamps, disconnects hot wires and does many other hot line jobs. Safety catch and sliding hand grip adjusts and holds the claws in various positions as shown at right.

TIPS TOOL CO.
DIVISION OF A B CHANCE CO
TAYLORVILLE ILL. CENTRALIA MO.

Economics of (Subsidized Power)

[*Continued from page 48*]

view that when public enterprise engages in the fields of business or industry outside of necessary functions of government, in which private capital is also engaged, that the rates charged by public enterprise should earn the normal return on the capital invested and the equivalent of the taxes which would be paid by private enterprise. Under this plan the net earnings over and above operating costs and depreciation are paid into the public treasury and the benefits accrue to all the taxpayers. Obviously, the taxpayers stand in the same relationship to such public enterprises in the field of private industry as the stockholders of a private enterprise. The taxpayers supply the capital or the credit which is necessary to finance public enterprise, and they also stand the losses if any, and receive the benefits of the profits. Such a fiscal policy in the management of public enterprise confers no subsidy on the consumers at the expense of other taxpayers.

Few private enterprises can long withstand subsidized competition, particularly in markets which are oversupplied. The natural trend of such competition, backed with large supplies of taxpayers' capital for expansion, will be toward ultimate socialization of public service industries. There have been many proposals and experiments in this direction, in our own country and particularly abroad, over a long period of economic history. However, it has never been the American way, and no results obtained in other countries encourage its adoption here.

•

New Air Unit Contracts

Contracts for seven air-conditioning plants were closed in Chicago in January, according to a report made by the Commonwealth Edison Company. This compared with 29 contracts closed in January, 1937, which was the largest January total on record. Aggregate plant capacity of last month's contracts was 197 hp., compared with 1,657 hp. for January last year. The total number of air-conditioning plants installed or under contract in Chicago at the end of January, 1938, was 1,930, and the aggregate capacity was 70,404 hp.

This design is ours . . . .

We are proud to claim the design and development of all-metal public utility bodies as they are accepted in the field today. It was through our sponsorship that these standard flexible units with their innovations of safety, speed, and lower maintenance gained general approval.

As the leading manufacturer of standard public utility bodies and equipment, we are also the only company devoting its efforts exclusively toward their development. Our mechanical improvements to winches and power take-offs have contributed to the present efficiency of pole setting equipment.

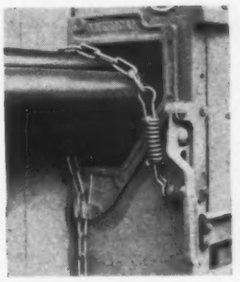
Throughout our progress we have fortified ourselves with underlying mechanical and design patents to the extent that the production of similar bodies is virtually impossible without encroachment upon our patent rights.

To the buyers of this type of equipment we offer the advantage of a pioneer's experience, as well as the facilities for producting at a value never before possible.

Our equipment has been designed by our engineers, proven under our supervision, and is basically and thoroughly patented. The illustrated body and transmission equipment is covered by mechanical and design patents as follows:

105114	1999612	1923787
100868	103460	2014140
92009	2063388	1944439

Also other patents. Further patents pending.



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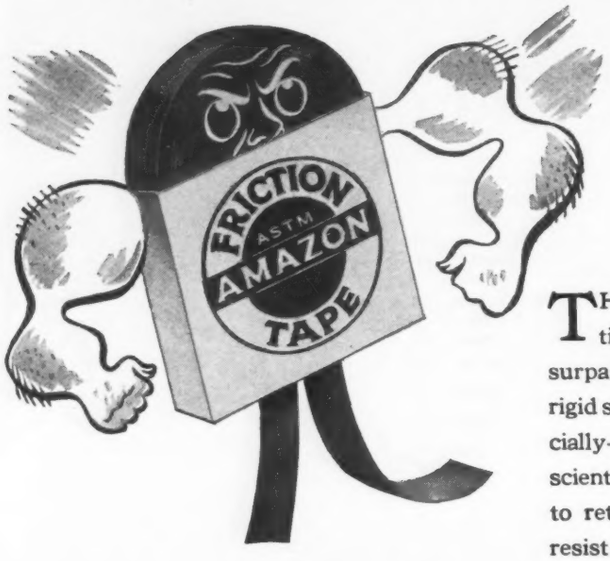

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THE FOSTORIA PRESSED STEEL CORP., FOSTORIA, O.

Demand Registers Tested Rapidly

[*Continued from page 50*]

which is mounted on the base in the rear of the checker.

All four registers are mounted on a plate that will slide horizontally about an eighth of an inch. This plate is pushed to the right by a spring, and when it is in this position the two left-hand registers are engaged, the upper one with the shaft that meshes with the register under test and the lower one with the synchronous motor that registers the length of the time interval. Pushing the little arm downward (shown in Fig. 1, between the upper and lower registers and to the right) straightens a toggle against this spring tension and pushes the plate toward the left, engaging the two right-hand registers. The checker is always started with the arm in this position.

Switches are then arranged so that the control switch is operated by the contact made at the end of the first time interval after the register is mounted on the checker, starting the timing motor and also setting the disk in motion. The switches are rearranged so that at the end of the next time interval the contact will energize an electromagnet which breaks the toggle, allowing the spring to push the plate on which the four registers are mounted to the right. This disengages the two right-hand registers and engages the two on the left, thus ending one check and starting another.

The demand-indicating pointer must then be read and pushed a little toward zero, but not far enough to touch the pointer pusher. The switches must be rearranged, this time so that the contact made at the end of the next interval will operate the control switch, which stops both the timing motor and the driving motor, and ends the second check.

Handling of demand registers was speeded up to some extent by the device of Fig. 1, since it left the attendant more time to clean and repair registers. Also, there were no checks lost due to the attendant forgetting or being unable to take readings at the end of the time interval. However, while test results obtained by this type of checker were highly satisfactory, the testing cost per register was felt to be higher than necessary, since only one register could be tested at a time.

Gang checker also developed

Accordingly, a testing device was developed which would test several registers at the same time. Three of these checkers were built, two of which are shown in Figs. 2 and 3. Although there are apparent differences in the two checkers shown, they embody the same fundamental idea of simultaneous testing applied to maximum demand registers. The disk of an indicating type demand meter drives the demand-indicating pointer forward for a thirty-minute interval, then the timing motor resets

the pointer pusher to zero, leaving the demand pointer at its highest point. This recurs continuously as long as there is a load on the meter. If an accurate demand register can be meshed with a shaft that is moving at a constant speed the pointer pusher should reach the same point during each time interval, and the demand-indicating pointer should remain at this point for the length of time deemed necessary to run a test on the register.

Checks test two makes of meter

This is the principle of operation of the apparatus shown in Figs. 2 and 3. Both checkers are driven by a synchronous motor. The checker shown in Fig. 2 is driven by an electric phonograph motor mounted underneath the table top. The other, shown in Fig. 3, is operated by a high-torque Warren motor which is mounted in the square gear housing shown at the lower middle of the board. The shafting is mounted on ball bearings and is gear-driven throughout so that there can be no slippage. In addition to a check on all registers of at least two time intervals at both full and light loads a test is taken at 50 per cent overload and then the register is run for 24 hours at full load further to check the accuracy of operation of the timing motor and resetting mechanism. The two horizontal rows of registers in the upper section of the checker shown in Fig. 2 are controlled by separate gear shifts, while the eight perpendicular rows are divided in the middle, the left half being controlled by one gear shift and the right half by another. The 52 registers shown mounted on this checker represent about three days work by one man. With this separate gear-shift arrangement light load checks can be taken on registers that were cleaned and adjusted one day at the same time that full load checks are taken on the ones adjusted the day previous. This is a desirable feature in that it evens out the flow of registers completed, instead of pyramiding three days work and releasing all of it at once. The checker shown in Fig. 3 has the same feature, but has only two gear shifts, one controlling the left half of the registers and the other the right half.

The checkers shown in Figs. 2 and 3 are both designed to test registers

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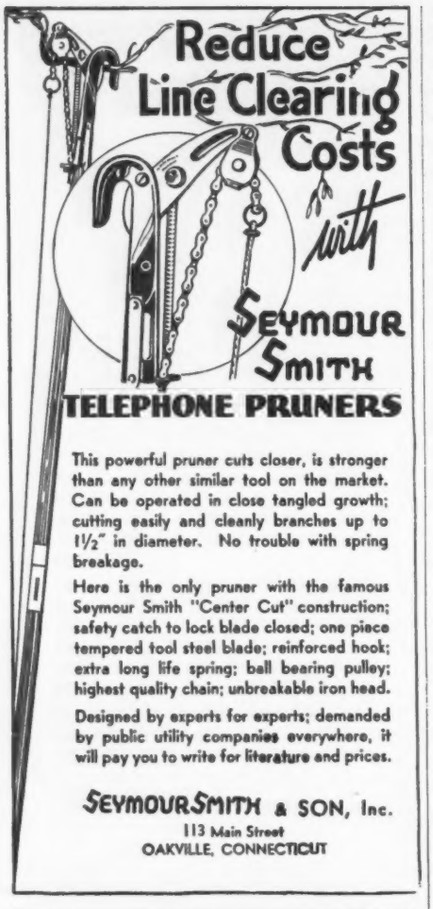

This powerful pruner cuts closer, is stronger than any other similar tool on the market. Can be operated in close tangled growth; cutting easily and cleanly branches up to 1½" in diameter. No trouble with spring breakage.

Here is the only pruner with the famous Seymour Smith "Center Cut" construction; safety catch to lock blade closed; one piece tempered tool steel blade; reinforced hook; extra long life spring; ball bearing pulley; highest quality chain; unbreakable iron head.

Designed by experts for experts; demanded by public utility companies everywhere, it will pay you to write for literature and prices.

SEYMOUR SMITH & SON, Inc.
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made by two different manufacturers. The meters from which these registers are removed have different disk contacts, which would result in corresponding differences in demand readings if they were driven from shafts rotating at the same speed. Since their disk constants have a ratio of nine to five, the shafting was arranged so that through beveled gears of that ratio the shaft speeds were changed to a ratio of five to nine, which resulted in the same demand being indicated on both types of registers. Mounting the registers to be tested was made as rapid and convenient an operation as possible. Adjustable friction mountings were used for both types of register as well as slip-on connections for the timing motors.

It was found that registers that were in error at light load might not be so at full load or the per cent of error might change with a change in load. It was felt, therefore, that to obtain an accurate test it was necessary to check all registers that were in error at approximately the same load at which they had been used on the customer's premises. All incoming registers are, therefore, tested on these boards and those that are found to be in error are further tested on the automaic checker, since a test at the approximate load at which they operated while on the customer's premises is not usually available on the gang checkers.

•

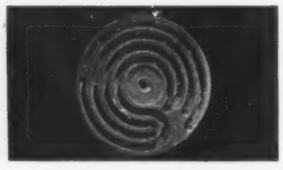
Seattle Sets Date on Bids

Following approval of plans and specifications by Seattle Board of Public Works for a double-circuit transmission line from Gorge plant to south receiving substation in Seattle, City Light Department tentatively set March 17 as date for opening bids for project estimated to cost in excess of $200,000 and for which $230,000 is available. Work involves stringing 116 miles of six-wire line, or approximately 700 miles of wire. Practically all of the material will be furnished by City Light.

•

Battery Imports Into Canada

Imports into Canada of electric storage batteries during the first nine months of 1937 amounted to 127,582, according to the U. S. Bureau of Foreign and Domestic Commerce. Of this amount, 76,713 were supplied by the United Kingdom and 50,541 by the United States.



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Heat - resistant, refractory porcelain for electrical heating devices where sudden changes in temperature occur. Used extensively in electric ranges, irons, air heaters, radiants, rheostats and immersion heaters.

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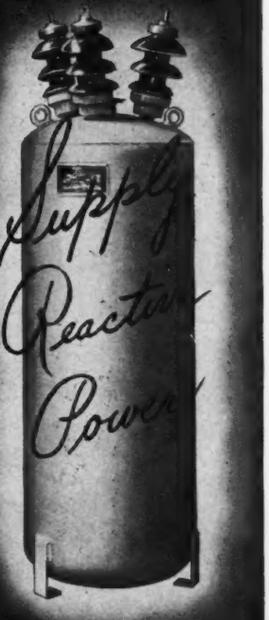


PRODUCTS PROTECTION CORPORATION
Affiliated with
The Safety Car Heating and Lighting Co.
230 Park Avenue New York, N. Y.

Commercial Cooking Loads Found Highly Satisfactory

[*Continued from page 52*]

erating cost fixed in the average restaurant man's mind in connection with electric cooking, the importance of this phase of a sales campaign may be readily seen. Several hundreds of this item were sold over the system and the users have been highly enthusiastic about their performance. Our hopes have been more than justified with the results of this campaign in opening up prospects for other pieces of equipment. Another important advantage of the campaign on electric deep fryers was that its success convinced our own salesmen that they could sell electric commercial cooking and that it would stay sold.

Intensive direct mail coverage featuring a free trial of the equipment in the customer's establishment was the backbone around which the campaign was built. Each salesman was provided with several sets of temporary wiring facilities and equipments for demonstration. The kettle was installed and put into operation by the salesman, who stayed with the customer long enough to be certain that he understood its operation fully. Approximately 80 per cent of these demonstrations resulted in sales.

Similar procedure was followed on subsequent campaigns on other devices which were possible to demonstrate in the consumer's establishment, such as broilers, grills, griddles, food-warming equipment, etc.

Complete kitchen survey

Where a prospect is developed for a complete electric kitchen for a large restaurant, hotel, school or hospital, a very complete survey of the customer's problem is made and a proposal covering all phases of the proposed installation is furnished to the prospect. Such proposal covers the following subjects:

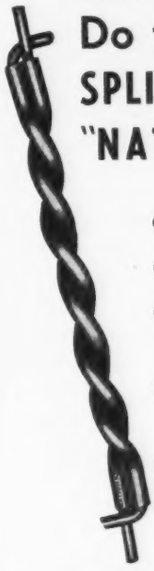
Comparative cost analysis for electricity and competing fuel covering the following items: Interest on investment, depreciation, maintenance cost and fuel cost.

Savings to be made with electric equipment to include: Saving on meat shrinkage, baked goods spoilage, cleaning expense and ventilating cost.

A list of recommended equipment with statement of particular advantages of each equipment, prices, etc. A catalogue descriptive sheet covering each item is generally attached.

A list of electric installations, with particular emphasis on installations similar to the proposed one.

YOUR LINE JOINTS ARE TREMENDOUSLY IMPORTANT – For Highest Efficiency Do the Splicing Jobs with NATIONAL SPLICING SLEEVES . . . When You Use "NATIONALS" You are Sure . . .



- That every splice will have maximum strength—
- That the line joints will be tight as a weld—
- That each splice will be uniform with every other—
- That the joints will be quickly and easily formed either on the poles or on the ground—
- That the work will be done at minimum expenditure of time and labor.

NATIONAL SEAMLESS SINGLE TUBE SLEEVES

are made exact to size from the best grade electrolytic copper—carried in a range from 10 B&S to 500,000 C.M.

THE NATIONAL TELEPHONE SUPPLY COMPANY

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Crapo Galvanized Wire and Steel Strand can be spliced and served without injury to the heavy, protective zinc coating. The perfect adhesion of this tough, ductile coating to the wire enables it to withstand sharp bending and twisting, produces corrosion-resisting joints, makes for longer life, lower maintenance costs.

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Include all supporting data possible, such as results of meat shrinkage tests, copies of testimonial letters, etc.

During the year 1937 our commercial cooking sales organization consisted of a total of ten men. Eight are assigned to the company's various divisions, one as salesman-driver of the traveling trailer exhibit and one supervisor. With approximately 4,000 commercial cooking accounts served by our company, this gives each of the territory salesmen an average of 500 consumers to solicit. In some territories 300 commercial cooking consumers will be all that a salesman can handle and do justice to his territory. In our own case, we have a great many road stands and small establishments at the beach resorts, so that between 400 and 500 accounts per salesman strikes about the right balance. Average new annual revenue secured per salesman for the year will approximate $15,875, the total being $127,000. The promotional expense for securing this business was 33 cents per dollar of new revenue secured. Kilowatts connected were 3,850 with an average annual revenue of $33 per kilowatt. Average rate was 2 cents.

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Low Cost Performance
The SMITH
AIR COMPRESSOR
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Lines all over the world testify to J-D QUALITY.

If you are a J-D user, CONSULT THE RECORD—if not, CONSULT US.

THE JEFFERY-DEWITT
INSULATOR CO.
KENOVA . . . . . W. VA.

Limits of Monthly Charges for Carrier Relay Protection

[*Continued from page 43*]

maintenance. These two figures of $40 and $100 are intended to give lower and upper limits of the probable actual monthly cost per terminal of power line carrier relay protection.

Naturally the cost of pilot wire circuits is almost entirely on a mileage basis, since the terminal relays are simple in most cases. The deduction from this is in agreement with your statement that the pilot system of relaying is indicated for shorter lines and carrier for the longer.

E. E. George,
Tennessee Electric Power Co.,
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•

Provides New Facilities

National Transformer Company, Jersey City, N. J., has arranged for the lease of a one-story building in Paterson which it will modernize and improve at once for a new plant. Present works will be moved to the new location and facilities will be provided for increased production. The company has taken an option to purchase the property as a permanent location for plant.

HIGH GRADE
HARD PORCELAIN
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IMPERIAL
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K-P-F
AIR BREAK SWITCHES

WILL LOWER COST
K-P-F ELECTRIC CO.
855 Howard St., San Francisco

TVA Formula Upset by Ross Plan

[*Continued from page 70*]

or they would not propose such an abject surrender. For recent Supreme Court decisions, and the presence of Hugo L. Black on that august tribunal, were pretty fresh in mind.

So after much backing and filling, after Lilienthal and Harcourt A. Morgan had appealed to the President to throw Chairman Arthur E. Morgan out, and after the President surprised TVA enormously by suddenly making public that demand, Lilienthal made a counter-proposal.

Lilienthal in this proposal did not go quite as far as Rankin's "second-hand junk" idea of value. But he was right with the President's previously described "prudent investment" formula.

"The actual legitimate cost of the properties, less the depreciation accrued since they were installed," is the way Lilienthal puts it.

A tip to Mr. Willkie: How about suggesting that J. D. Ross be the arbitrator?

Heating Engineers Issue Air Conditioning Guide

Announcement has been made by the American Society of Heating and Ventilating Engineers, New York, of the publication of the 1938 Heating, Ventilating and Air Conditioning Guide, official reference book of the society. This year's issue contains 840 pages of technical reference data covering material on design and specifications of heating, ventilating and air conditioning systems.

In addition to the technical material, more than 300 pages of catalogue data by 218 manufacturers is included, as well as an index to modern equipment listing 300 items, cross indexed as to product and manufacturer.

•

Orders Total $1,000,000

Orders for air-conditioning equipment booked by Carrier Corporation since January 1 total more than $1,000,000, according to L. R. Boulware, vice-president and general manager. The company is at present employing 1,489 persons in its plant in Syracuse and 507 in the field, with the total less than 200 short of peak employment since the company moved its operations to Syracuse and started production in that city five months ago.

LINCOLN DEMAND METERS

TYPE WD

Eliminates
LOSS OF DEMAND READING

Absence of all rapidly moving parts, contacts, and timing mechanisms results in a meter of exceptional dependability and eliminates loss of demand readings.

SEND FOR YOUR COPY OF CATALOG TO

LINCOLN METER COMPANY
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Abbott's

NATIONAL ELECTRICAL CODE HANDBOOK

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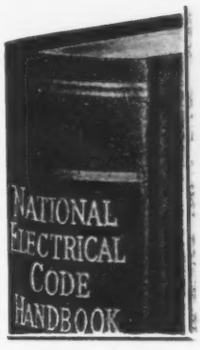

The 1937 National Electrical Code is a new code, entirely new in arrangement, more than 50 per cent new in wording, contains important new rules. And Abbott's Code Handbook has been completely rewritten to correspond with the new Code.

Save time and trouble in getting a command of these new features of the 1937 Code:

Branch Circuits—Now classified according to fuse rating or circuit breaker setting as 15-, 20-, 25-, 35-, and 50-amp. circuits. House wiring circuits depend upon floor area, regardless of number of outlets.

Appliances—Five special types of circuits specified.

Feeders—Standard loads for some occupancies considerably increased. For ranges of 3,500 watts or higher rating, new demand factors apply to feeders.

Panel boards—Important change made in requirement for over current protection.

Services—New rules governing number of sets of service entrance conductors to one building and number of switches and fuses, or circuit breakers, for control and projection of each service.

Motors—Rules formerly appearing in old Articles 8 and 10 now consolidated in one article; so changed in wording and arrangement that they must be studied carefully to find what changes have been made.

10 DAYS' EXAMINATION ON APPROVAL—SEND THIS COUPON

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Name .....

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Position ..... Company W.3-12-38

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ROME, N.Y.

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HOT ROLLED COPPER RODS
BARE & TINNED COPPER WIRE
(In rounds, flats & squares)
BARE & TINNED STRAND
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FLEXIBLE CORDS
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ROME, N. Y.

SALES OFFICES:
New York Chicago
Cleveland Pittsburgh Boston
Richmond Philadelphia Dallas
Los Angeles

Legislatures Pass on Utility Bills

New measures affecting the electric light and power utilities have been placed before the various state legislatures. Among the recent legislation is the following:

MASSACHUSETTS—Wycliffe C. Marshall has sponsored a bill which would require the Department of Public Utilities to hold hearings in communities filing complaints against electric and gas rates and advertise such hearings in local papers. While not objecting to the bill, Chairman Sullivan of the commission cited the difficulties which would follow the enactment of such legislation, which he said was excellent in theory. Sheldon Wardwell, counsel for the New England Gas & Electric Association, and David B. Hoar, representing the New England Power Association, opposed the Marshall bill. That portion of the bill touching on certain phases of municipal plant operation was opposed by the Municipal Lighting Managers Association. Mr. Wardwell maintained that the bill would strip the Department of Public Utilities of power over the utilities rather than increase such power. Representative Zimon of Boston has filed a bill to force electric light companies to furnish free bulbs to customers.

NEW YORK—Under the provisions of a bill introduced in the Senate by Thomas F. Burchill, Democrat, of New York City and in the Assembly by Arthur J. Doran, Democrat, of Yonkers and referred to public service committee in both houses the public service law is amended to permit cities, villages and towns to file complaints with commission against municipally furnished gas or electricity as now allowed against private company; also requires municipal ownership and operation to be at lowest rate necessary for adequate service. Another bill by Senator Burchill, introduced in the Assembly by Lawrence J. Murray, Democrat, of Haverstraw, empowers public service commission to prescribe uniform methods of accounting for depreciation by public utilities and municipalities to ascertain, fix and determine rates of depreciation and proper amount of reserve therefor.

These bills were recommended by the Governor in his annual message to the Legislature. A bill was introduced in the Assembly by Arthur J. Doran and referred to public service committee, requiring filing and approval by Public Service Com-

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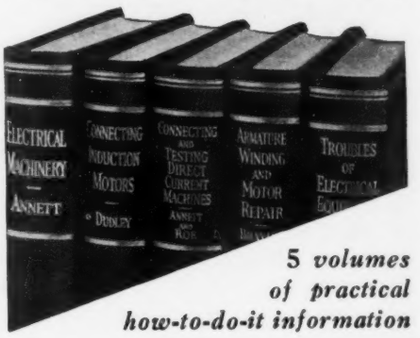

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